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[OFFICIAL NOTICE.]

Seventh Annual Meeting, Pacific Coast Gas Association.

OFFICE OF THE SECRETARY,
OAKLAND, CAL., June 7, 1899.

The seventh annual convention of the Pacific Coast Gas Association will be held in the city of San Francisco, Cal., on Tuesday and Wednesday, July 18th and 19th, 1899, commencing at 10 A.M. The meeting place will be the office of the San Francisco Gas and Electric Company, No. 413 Post street.

Papers will be contributed by:

"President's Address," by Mr. Charles F. Adams.
"Coal Combustion," by Mr. John L. Howard.
"Electrolytic Trials," by Mr. Wm. A. Aldrich.
"Gas Stoves, from Foundry to Consumer," by Mr. L. Kahn.
"Determinations," by Mr. J. B. Grimwood.
[Title to be announced], by Mr. Oscar B. Weber.
"Experiences," by Mr. F. H. Eichbaum.
"Historical Review," by Mr. W. M. Parker.
"Wrinkle Department," edited by Mr. G. H. Hollidge.
"Experience Department," edited by Mr. John Clements.

An excursion on the Bay of San Francisco, to the Union Iron Works, Mare Island and other points of interest, will be made on Thursday.

The Secretary will be in attendance at headquarters, No. 413 Post street, Tuesday, until 10 P.M., to meet members and afford information.

Queries for "Question Box" should be sent in prior to July 15th for assignment to members.

JOHN A. BRITTON, Secretary.

BRIEFLY TOLD.

THE SIGNS OF THE TIMES.—He would be wise indeed who could successfully forecast the future of the gas business, not in respect of its growth, for that is to be limited only by the growth of the world, but in the illustrating of the methods of those who are to control its advancement. Twenty years back, because of the then results of the study and thought of Jablochkoff and Edison, it was said that the gaseous days were numbered; but 20 years forward we are confronted with the old fact that gas more than holds its own. In 1879, for instance, the entire output of gas, in what was then the city of New York, amounted to perhaps 5,000 million cubic feet per annum; whereas today the output shows considerably in excess of three times that figure. It is true that the legal selling rate now is considerably under the legal selling rate of 1879, but the decrease in the sales' rate has been far outpaced by the increase in the *pro rata* of consumption. Meanwhile gas has encountered the competition of electricity, fostered, too, by every aid and assistance that local authority could give the latter in the competition; but the fostering has been wide of the mark, for, if private and public lighting are to be performed at their cheapest and best, the agent that will accomplish both most satisfactorily is gas. And in that accomplishing the gas shareholder will have returned to him a far

fairer profit than the shareholder in electrical supplying will receive The accounting for this seeming anomaly is simple. The gas man and the electrician use or employ virtually similar agents for the production of the matter that they sell, but the method of treating the matter is quite different, in that the former does not eat his cake before he makes it, and, having made it, if he watches even ordinarily well, he knows where it is all the time. Carbon, of course, in some shape or other, is the beginning and the end of the making of gas and electricity, so far as such manufacture is concerned in lighting, heating or power supplies, and its easiest transformation and conservance to the point of use are the things that tend to its better use commercially, either from the consumer's or producer's standpoint. Loss of energy is about equal to the conservation of energy in the case of gas distribution, but the electrician's loss comes in twice when he essays to distribute. However, the lesson which seems to be taught by the signs of the times is that those controlling electric lighting plants, in even large centers of population, are extremely anxious to secure ownership in the gas plants, to the end that charges to consumers may be regulated on the electric rather than on the gas basis. This would seem to be especially true of New York city at the present time, the current control of the lighting of which from central stations is being bitterly disputed; but the result of this contest, which is merely instanced as a sign of the times, will only go to show that gas will remain the money maker until such period as the hopes of the Tesla school of electrical current suppliers are proved realities rather than pure fancies.

VITRIFIED CLAY PIPE INSTEAD OF IRON FOR GAS MAINS.—Our current number contains the closing chapters of the proceedings of the last meeting of the Western Gas Association, and in the records will be found a paper, by Mr. Irvin Butterworth, of Columbus, Ohio, on the subject named in the foregoing caption. Titularly, its inspiration is revolutionary, but its lines are far from either revolutionary or impractical; in fact, we look for them to bear good and peaceful results. There is no seeming good reason why vitrified clay pipe should not be used for conveying gas; in fact, it is rather queer that its extended employment on such account had not been practiced long ago, or at least since a good, sound article of the sort has been easily attainable, which opportunity has existed for many years. Perhaps the main objection to its use has been the lengths to which it has been ordinarily built, but the "long or the short" of it will not be a final bar, in that there is no good reason why it may not be moulded to any fair length. To our thought the scheme looks perfectly feasible, and it is our belief that its trial on an important scale is but a question of short time. Mr. Butterworth is to be congratulated, no matter what the nature of the role was that he played, on his courage in setting his subject out as he did.

NOTES.—Mr. Nicholas Doyle, formerly of Newark, N. J., has been appointed Manager of the Haverhill (Mass.) Gas Light Company.——The Lighting Committee of the Camden (N J.) City Council has agreed to award the public lighting of the city, so far as the same is performed by gas, to the Camden Gas Light Company for the period of one year. The price agreed on is $20 per lamp, on an all night and every night basis.——At the annual meeting of the Lockport (N.Y.) Gas and Electric Light Company the following officers were chosen: Directors, H. B. Wilson and S. R. Bertron, N. Y.; Denman Blanchard, Boston; and S. Curt Lewis, A. H. Ivins, H. J. Chadwick and E E Witherby, Lockport; President, H. B. Wilson; Vice President and Secretary, E. E. Witherby; Treasurer, A. S. Cooke; Assistant Secy. and Treas., W. F. Douthirt. From the Superintendent's report the stockholders had the satisfaction of knowing that the net earnings of the Company, for the year ended June 30th last, amounted to something over $25,000. ——Upon the purchase of the plant of the Charlotte (N. C.) Gas Company by the Charlotte Consolidated Construction Company the old works were shut down, the supply of the city being altogether carried on from the new works. The gas business of Charlotte, however, has so increased that the Construction Company has been obliged to extend its generating capacity, with the result that a contract therefor has been awarded to the United Gas Improvement Company. Under the terms of the contract the U. G. I. folks will install a set of standard, double superheater water gas apparatus up to a daily capacity of 250,000 cubic feet.——The last act in the consolidation at Memphis, Tenn., has been played through the union of the pipes of the New Memphis and the Equitable Gas Companies. The plant in South Memphis is to be shut down.——At the annual meeting of the Peoples Gas Light Company, of Rutland, Vt., the Directors elected were: S. M. Wilson, J. W. Cramton, Geo. H. Verder, Thomas J. Lyon, Charles W. Mussey and F. A. Field.

[OFFICIAL REPORT—REVISED BY THE SECRETARY—CONCLUDED FROM PAGE 53.]

PROCEEDINGS, TWENTY-SECOND ANNUAL MEETING, WESTERN GAS ASSOCIATION.

HELD AT HOTEL PFISTER, MILWAUKEE, WIS., JUNE 14, 15 AND 16, 1899.

SECOND DAY, THURSDAY, JUNE 15—AFTERNOON SESSION.

The Association reconvened at 2 o'clock, P.M., President Copley occupying the Chair. At the suggestion of the President the proceedings were opened by finishing the contents of the

QUESTION BOX.

No. 6. "What methods can be recommended for the better using or disposing of tar?"

The President—Has anyone an idea on this subject?

Mr. MacMillan—A good way would be to burn it up. I understand that only about 1½ to 2 cents per gallon is offered for tar, and so I think the better plan would be to use it as fuel.

Mr. Kellogg—I read a statement not long ago which showed that tar had a value of 5 cents per gallon when used in the generator on the down run. I am not prepared to give the details, but it was claimed that it was worth more in that way than in any other.

The President—Can Mr. Butterworth answer the question?

Mr. Butterworth—At Columbus we have been distilling our tar for the last five years, and to very good advantage. We have in the past week disposed of our tar for the next five years. I do not know at present of any better way of permanently procuring better results, or of developing more revenue from tar, than by distilling it.

Mr. Odiorne—This suggestion may be of some avail. In the putting down of brick pavements see that the parties interested have the specifications include coal tar joints. This is a great advantage. It is so used in Chicago largely, and those in many other places might in this way provide profitable means for using some of the tar.

Mr. Atwater—If my recollection is accurate for the last 10 years tar has been worth only 3 or 4 cents per gallon. If I am wrong in that statement I would like to be corrected.

Mr. Odiorne—Nearer three than four.

Mr. Atwater—Nearer three than four at the point of production, but perhaps nearer four than three at the point of consumption. I think I am also right in saying that the price has now fallen at the point of production to nearer two cents than three. Therefore it becomes a material question whether other methods can be devised whereby the demand for and value of tar can be increased. Ultimately tar can be burned, and it has a fuel value of perhaps 1½ times its weight of coal. That is, if coal is worth $2 per ton tar is worth about $3 per ton to burn. That is certainly a low valuation, although there is a slight saving in freight which might be considered. If it is possible to get any further utility out of that product than simply its fuel value, I think we are all interested in knowing it. I am specially interested in it, and wish to do anything I can to ameliorate the present condition. In Europe the practice has been to turn the tar into the form of briquettes, and to day the tar and pitch have a greater value there than they have in this country. Perhaps I may be wrong in that statement, but the last quotation I saw was 25 shillings per ton in London, or $6 per ton, which I think is better than 2½ cents per gallon. Pitch is worth about $6 or $7 per ton there, which perhaps is not so very far different from the price here. As a great deal of pitch has been exported from England to this country it would seem as if the price here ought to be as good as the price there. The foreign pitch has been largely absorbed in the making of briquettes—a form of fuel of which we know very little about here. I have used them abroad and find them to be a very usefuel fuel. The conditions in this country, with cheaper coal and longer haulage for the briquettes, would affect the demand for the latter, and I do not know whether those conditions can be overcome; but it does seem to me that, either in the form of briquettes or in some other form, it should be possible to get a higher value for tar than we are obtaining at the present time.

The President—Can Mr. Steinwedell tell us what they are doing with coal tar in Germany?

Mr. Steinwedell—The principal use of it there, so far as I am informed, is to distill it. This is especially so in the case of Russia, where they have at Warsaw a very large tar distilling plant. Of course, in a plant of that kind, it is requisite to have the most efficient apparatus and also experienced men to handle it. The aim in such works is by working up the tar to reap all the profit instead of having it go through

other hands. It is a very common practice there to heat parlors with briquettes, which are made from coal dust, ground up and cemented together with pitch and tar which had been boiled down. I have never seen it used for heating benches.

The President—The next question is:

No. 7. "In view of the unprecedented leakage of last winter, what ratio of generating capacity to maximum daily output can be considered safe in small coal gas works?"

Mr. Bredel—A two-hundredth of the yearly output. There are some places where it might be even the year round. As the "unforeseen leakage" of last winter depended upon unknown conditions, this is rather a difficult question to answer.

The President—It seems to me Mr. Bredel has answered that it will depend entirely upon what the age of your horse is. The next query is—

No. 8. "Does it pay gas companies to pipe houses?"

Mr. Odiorne—I can give some experience in piping houses. About three years ago we had many small houses along our lines of mains which had no pipes and no connections with street mains, and found that the people along those streets had been discouraged about putting in pipes by the fact that the cost was so great. Going to a plumber or gasfitter to make inquiries he would measure for the work, and his estimate of the cost would be so great that it was practically prohibitory. We sent a canvasser along the lines of our mains, who took with him samples of gas fixtures, brackets, etc. He told the occupants of a house just what it would cost to pipe the place, set the fixtures and brackets at the necessary points, run the services and set the meter. Then he added they could pay $2 down, and thereafter pay $1 per month on account of the bill. In that way we got a great many customers and found that after they had used gas in the house, and had the fixtures and piping paid for (the next year probably) they would want a gas stove. We further found that class of customers about the best we had, in that they grumbled less, appreciated the worth of the gas stoves and paid their bills promptly and cheerfully. I think we got over 300 new customers in our town the first year after taking up this piping business. We arranged to do that piping very cheaply. We rigged up a wagon with the necessary pipe vise, box of tools and fittings. The man with his helper went right to the house, took the measurements, went out to his wagon and got the pipe and put it in. He had no excuse for running back to the shop for tools that he had forgotten, or found that he had a pipe that had split, or one that had a sand hole in it, or anything of that kind, to make delays in the work. He did the work very quickly and cheaply, and it proved to be one of the best paying investments we have made.

Mr. Mitchell—What did Mr. Odiorne figure the cost per drop at the house?

Mr. Odiorne—In old houses we figured it at $1 per drop—if everything is tight, $1 per drop will pay for them. If he finds a leak that is so difficult to locate that it takes extra time to go over the piping, we charge an additional $1. In new houses we charge $1 for every opening, and if there were a number of openings we charged a trifle less than that.

The President—The next question is—

No. 9. "Should 60° F. be taken as standard for correction in computing our records for comparison with our distribution records of gas sent out? In other words, would it not be more nearly right to base our correction on atmospheric temperature for making a record on which to judge our leakage and the accuracy of our meters?"

Mr. J. R. Lynn—Replying to the query, I would reiterate the statement made in a previous discussion upon the same subject, that corrections for atmospheric conditions would not lessen the complication. In fact, such a plan would only tend to complicate matters to a greater extent, owing to the impossibility of ascertaining the average temperature at the final points of registration—at the consumers' meters. If a correction be made at the station meter, with the purpose of arriving at exact loss, the necessity of further and more complicated corrections naturally follows. It is reasonable to suppose that when we obtain the highest average at our works we shall also find the maximum at the point of consumption, and vice versa. A correction to a standard in the summer, therefore, increases indicated leakage, while in the colder season one has a contra effect. It does not follow that averages would be the same or that variations between the points considered would always be through the same range. Viewing the matter in such a light, one is compelled to say decidedly that it is best to consider all meter statements exactly as we find them, independent of atmospheric variations. With properly condensed gas there is no more occasion for alteration in indicated registration of production than there would be for several hundreds or thousands in sales to consumers. There is no more reason why 60° should be considered a standard than that one should substitute as such the mean average temperature and barometric pressure of the locality in which his product is sold. Upon this latter it might be even more proper to base adjustment of meters, but that plan would also possess serious disadvantages, due to various locations of consumers' meters, under houses, in exposed areas, or almost in direct contact with furnaces or boilers; also, the temperature of soil through which mains and services pass, and the rate of consumption governing the length of time our product is in contact with affective conditions. When one makes corrections under such variety of disadvantages, he is obviously drawn from safe, shallow water into a deep, dangerous current. Temperature is not the most prominent cause of leakage as expressed by percentage. A large consumption per mile of main, with constant and careful repairs to the distributing system, not only reduces percentage of loss, but also, what is more desirable still, increases earnings. Corrections at works profit nothing.

Mr. Gimper—What would the gentleman do in my case Our station meter is in a little building in the yard where it is exposed to the rays of the sun from sunrise until sunset. The gas being measured at a very high temperature, therefore, shows a very high yield; but I do not believe we sell our gas at half that temperature. All other meters are better protected than our station meter. I take the temperature of the gas eight times per day and reduce it to an average, and at the end of the month make the necessary correction.

Mr. Atwater—Do you take the meter temperature at the same time?

Mr. Gimper—Yes.

A Member—I would not set the station meter where it would be so exposed.

Mr. Gimper—There is a frame building over it.

A Member—I would not care to have a frame building about the gas works where such building could be avoided.

Mr. Bredel—I think each engineer should suit himself about making comparisons, yet, as we are accustomed to taking 60° as the standard, and as all our calculations are made for that temperature, I think we should keep to that standard. As to what a man does about his own works he can suit himself, but if he wants to make a statement to others as to what he is doing, then he should take 60° as the standard of comparison.

Mr. Jenkins—As a rule the principal object among gas engineers in fixing a standard of temperature is to find out something about their leakage. In other words, it is not to determine the heat, but to ascertain the amount of unaccounted for gas. Mr. Gimper, in getting his gas down to 60°, puts himself in an excellent position to have a very small quantity of unaccounted-for gas. I think that in Galveston, or in any territory of the far south, he should correct it to about 70° temperature and he would get nearer his sales. I believe he averages a temperature of over 60° on sales. If he is making it at 60° and selling at 65° or 70°, there would be times when he would sell more gas than he would make. I have thought the matter over during the fast few days since I first saw this question, and I believe that in the United States there ought to be three different standards of temperature for registration in order to compare with each other on the question of unaccounted-for gas. I quite agree with Mr. Bredel that, if we were figuring on yields only, we ought to have a standard of temperature, for that is the only standard we have to compare on. But the unaccounted-for gas is the principal thing. In a paper[1] which I read at Cincinnati, on Leakage," I said I believed the average temperature at which gas was sold in that section for the twelve months of the year was about 50°, and I still think I was about correct in that statement; but when you go south as far as Galveston I think gas is sold at nearer 70° temperature.

Mr. Doherty—I agree thoroughly with Mr. Bredel about the 60°, and think we should retain 60° as our standard and make our corrections at 60° for the conditions existing in the particular town. I made a running test for three months of the temperature of the water coming out of the ground from the city reservoir, and was surprised to find how close it ran to 60°, regardless of the atmospheric temperature. Now there are other ways of getting at this, but there is no use of changing unless we are going to get a better method. I think 60° should be used for all manufacturing comparisons, and I think we ought to reduce the temperature of the gas sold to 60° from the temperature at which it is delivered. Of course we can only get at that approximately. Two or three thermographs placed in different sections of the city would

1 See JOURNAL, June 14, 1897, p. 950.

give us the temperatures, and we could get a registration for different periods of the year and get it more accurately than we do now. I do not think that any of us considers that 60° on the average is very far wrong. Gas will not take the temperature of the ground very fast.

Mr. Gimper—I do not quite agree with Mr. Doherty in his statement that gas does not take on the surrounding temperature very rapidly. I think it is very quickly affected by the surrounding temperature. As soon as gas passes out of the warm ground the pipes take on the surrounding temperature, and we get naphthalene immediately.

Mr. Jenkins—My statement that the temperature of the gas as sold was about 50° was the result of a great many tests, made under the supervision of Gen. Hickenlooper at the works at Cincinnati. Thermometers were placed at different sections of the city and daily readings were made of the temperature of the gas which passed through those mains; and his report to me, before I read that paper, was that the average temperature at which gas was sold at Cincinnati was 50°.

Mr. J. T. Lynn—I will say for the benefit of Mr. Doherty that the average temperature at which gas is burned in Cincinnati is considerably less than 50°. I have lived in this section and have also lived in the neighborhood of Cincinnati, and when I have passed down to that section at this season of the year I have noticed a very great difference in temperature.

Mr. Jenkins—The temperature of the ground does not show that difference.

The President—The last question on the list is—

No. 10. "What is the effect of gas syndicates on the gas engineer and the public?"

Mr. Copley—At the request of President Thompson and of Mr. Dunbar I have given this matter a little thought, and have attempted to express my views on this question in a few words. It seems to me the true answer to this question is not of necessity entirely speculative. It is reasonably safe to assume that the relations of large syndicates to gas engineers and the public will be very much the same as they have been. When men associate themselves together for a particular purpose, nature does not vouchsafe them wisdom beyond the sum total of that possessed by each individual prior to such an organization; and I believe that no man here will dissent from the view that the only wise policy to follow when dealing with the public is that in which efficiency and economy of service to the public are made of paramount importance. The gas engineers can only be affected in so far as efficiency and economy in service is demanded by such syndicates and by the public. It seems to me a perfectly clear case that the ownership of gas companies by syndicates must affect the engineers and the public in exactly the same manner. The syndicates are composed of human beings. Some syndicates are good, others indifferent, and others, perhaps, not so good. The same may be said of every quality essential to a successful conduct of business. Some may be wise, and others not so wise; but it is safe to say that when a body of men are associated together for a specific purpose the sum total of the wisdom of the individual can most effectively be directed to obtain any desired end. From the examples we have had in the past few years of syndicate control, the conclusion would be inevitable that efficiency in production and service had been increased, and that economies have been obtained. Efficiency has been secured by an education of the gas engineers associated with such syndicate. For 22 years this Association has been assuring the public that its annual conventions have been of great value to its members and to the public. If such is the case, how much more progress can be made by the gas engineer, when all of the records, all of the experience and wisdom of several other, perhaps equally intelligent, engineers are at his disposal? If he has a particular talent for research in any one line, a greater opportunity is given for its development, because many of the thousand and one problems which arise are solved for him through the experience and accumulated wisdom of some of his associates, thus leaving him more time and more energy to turn into newer channels. I would say, to sum it up in a nutshell, that the effect upon a gas engineer would be more to his advantage if he were willing and able to increase his store of knowledge, but syndicates are apt to be more devoid of the sentiment of practical friendship than are individuals, and if a gas engineer is unable or unwilling to learn, I would conclude that the chance of continuing in a soft berth would be very much reduced through the medium of syndicate ownership. And it seems to me that the interests of the public are closely identified with those of the engineer, in case he can improve the service and render it more economical to his company, for it is certain that the public will immediately profit through increased efficiency, and may profit by a reduction of rates.

The President then introduced Mr. F. H. Shelton, of Philadelphia, Pa., who read the following paper on

DISTRIBUTING GAS UNDER HIGHER PRESSURE.

Mr. President and Members of the Western Gas Association: I do not ordinarily apologize for papers that I read before Gas Associations. In this instance, however, I exceedingly regret to say that I must. Only because of a promise made your President am I reading as herein; it having happened, when the time came for preparing my paper, that I found myself so much occupied in several matters of such moment to me that I simply could not take the time needful for investigating my subject. That condition of affairs having continued since, I have been quite unable to go into it as I had expected, to get exact information, or to secure the figures in detail that I would have liked to present to amplify and fortify my position. I have decided, therefore, to frankly say so to you, and to ask your leniency in your criticism, but in so doing to informally at least state to you what I had in mind, which, after all, may be as sufficient as a more elaborate paper, at least as far as bringing out discussion is concerned.

I have for some time been impressed with the low pressure at which illuminating gas is distributed, amazingly low when one thinks of it and compares it with the practice in the distribution of other fluids. I have been wondering at the reason of it; wondering whether there is good reason for continuing it, and wondering whether it would not be advantageous to distribute gas at a higher pressure than is the common practice.

Water is distributed frequently with pressures of from 100 to 300 pounds; natural gas is distributed at all ranges of high pressures, even the "low pressure" systems often ranging at a number of pounds pressure. Steam I believe is distributed in the most crowded streets of some of the principal cities at 200 or 300 pounds pressure. Low pressure steam-heating systems in house work operate at 1, 2 and 3 pounds pressure, which we think is almost no pressure at all. Yet illuminating gas is commonly distributed at but 2 or 3 inches of water pressure, which is equivalent to but $\frac{1}{8}$ or $\frac{1}{10}$ of 1 pound steam pressure. A mere zephyr, a pressure so slight as to scarcely more than induce motion, a pressure so slight that boys in dormitories by blowing down a burner can overcome the pressure for some considerable distance in the house pipes and extinguish lights in adjoining rooms. Why should not gas be distributed at higher pressures, not necessarily at 100 or 200 pounds (although just as well that if desired), but at any rate at 5, 10 or 20 pounds pressure, instead of $\frac{1}{2}$ or $\frac{1}{4}$ as many inches, and thus make small pipes handle large quantities of gas? According to accepted authorities, other things being equal, four times a given pressure will double the delivery of gas. Taking an average of 2 inches as a starting point in common practice, about 5 pounds pressure would mean, therefore, a delivery of about eight times as much gas as at present, and 20 pounds would mean about 16 times as much. If our distribution systems could, without replacing, be made to distribute from eight to 16 times more gas than at present, by comparatively simple and inexpensive additions and means, and without substituting large, new pipe, is not the idea well worthy of consideration?

Various reasons to the contrary no doubt occur, especially to those who are ever satisfied with present practice and who usually bring out objections to *any* proposed new departures. Enormous leakage, danger, loss of candle power due from compressing, the expense of individual house governors and the expense of the compressing machinery are all reasons that no doubt come to mind.

As stated, I have not had time to investigate at all the details of my subject. I can only give my ideas in general as they so far exist, without having as yet fully satisfied myself on some of them. For instance, I have not been able to ascertain the loss in candle power resulting from compressing ordinary gas, to say 20 pounds, and am thus unable to say either to you or to myself what that loss would amount to in dollars and cents on this feature of a high pressure proposition. My impression is that the loss with moderate compression, say to 20 pounds—but 10 per cent. of Pintsch practice—would not be a material point, and could be compensated for by a little greater enrichment, and that the point would not stand in the way if other points were right. Nor have I had a chance to ascertain the cost of compressing machinery, and of figuring its operation as against the interest on the investment of larger mains. The balance, however, must be far in favor of compressing, as the cost of a suitable exhauster for drawing gas from the holder and forcing it into the mains at a few pounds pressure (or of such a compressor as is used for air compression or by the Pintsch people) would be but a fraction of the cost of changing a system of gas mains to the sizes sufficient to handle several times present capacity.

In these days of delicate regulation and governors it further does not seem to me the *governing* of such pumping outfit should be a very difficult problem.

The leakage question to my mind is a more immediate one, especially in connection with existing leaky mains. To put a great many times more pressure on such would first require the overhauling of practically every joint, which expense of course would have to be figured against the proposition. But it is probably truthful to say that a majority of gas mains at large would no doubt be a good deal better for an entire overhauling, and when once done—in a manner to be suggested—the work would be done practically for all time. My idea is that, to make a present system tight for high pressure, it would be desirable and necessary to inclose each hub and spigot joint with a special fitting in the nature of a light cast iron sleeve made in two pieces, which could be bolted on to the pipe and envelop the joint, using a cement at the contact points for tightness, the original hub and spigot joint maintaining the strength of the main and the sleeve serving only to prevent the escape of joint leakage. To get at the joint would be easy, by simply unbolting and detaching such enveloping sleeve. *With a new* street main system, designed for high pressure, I should be tempted to use wrought iron pipe with screw joints and thus, in the simplest way, get tightness and insurance against leakage. I at once hear objections to the use of wrought iron pipe by those who are not in favor of such material for underground work. I think, however, that in view of the satisfactory experience had with wrought iron pipe by natural gas companies on a very large scale, it is time that some of our former views on this point be somewhat modified.

While it is customary for many of us to say that it "rusts out" and should not be used, the fact remains that, in I think the majority of cases, it does *not* rust out to the degree looked for in theory or hoped for by opponents, but remains pretty tight and sound and all sufficient for its purpose for very many years. Certainly a number of gas companies of the best standing use it freely. If I am not mistaken the Standard Gas Company, of New York city, uses it entirely, and, as I am informed, with the result of having a lower leakage account than any of the other New York companies. Certain it is that miles and miles of it are used by the natural gas people with apparently all sufficient satisfaction. I have seen some such pipe dug out after 12 to 15 years' service that looked as though it had just been put in the ground. I believe that (if well coated and laid with some judgment as to locality and nature of soil) ordinarily speaking, it will last a generation, and until the company can afford to replace it, or it has to be replaced by pipes of larger capacity. I certainly believe it to be preferable to cast iron for any high pressure system.

For those, however, who disagree with me and who would put in cast iron, it is undoubtedly possible to make a system tight in these days with cement joints; and, moreover, a system that will stay tight, short of absolute fracture. The lowest leakage accounts of which I have knowledge to day are on systems made with cement joints. Lead joints, of course, are good, and will hold any pressure, but they will not *stay* tight.

It was my intention to go into this question of pipe joints rather fully, describing the various ones out of the ordinary that have been tried by the gas companies in the past, as well as those at present on the market; but for the reasons already stated I have been quite unable to do so.

A principal objection to high pressure no doubt is that of increased danger in the event of broken pipes and leakage. Undoubtedly that objection has some force. However, it does not in practice seem to stand in the way of distributing natural gas, which is likewise highly explosive, and less apt to be noticed in the event of leakage because of its lesser odor. It does not stand in the way of handling Pintsch gas at pressures of some 200 pounds, through ordinary mechanical devices and equipment and fittings in the immediate vicinity of many people and under the most trying conditions. As far as pipe and fittings go, those which will hold steam, natural gas, water, ammonia, Pintsch gas and other such fluids at high pressures, will certainly equally well hold illuminating gas if desired. The pipe system can be made tight all right enough, and will stay so to a reasonable degree. It is true, occasionally accidents may happen, as in running anything at high tension or pressure, precisely as the high speed of railroad trains, the high voltage of electric currents, the high pressure of natural gas, etc., at times lead to accidents that are serious. But high pressure has not stood in the way of development, and in almost every business will usually be found accompanying a better service than before to the public and a cheaper operating expense to the company.

It would not be my idea to have any higher pressure than at present in the houses of customers; only in the streets and service pipes. I would expect to insert a regulator ahead of each meter to cut down from the several pounds pressure in the street to 15 or 17 tenths on the meter and house pipes, as at present. There are several regulators on the market that work perfectly well and dependably. They are not expensive. The repairs on such are practically nothing. The natural gas sections are full of them. The Pintsch and other railroad gas lighting systems use them universally, every day in the year, and get practically a perfect service.

On the question of cost, a company having, say, 1,000 customers, might equip them with regulators at an expense of $3,000 or $4,000. The interest on this investment is but $150 or $200 per year. Compare this with the cost of replacing from 10 to 25 miles of mains with sizes of pipe sufficient to distribute from 8 to 16 times more gas than at present, not forgetting the fact of avoiding the general opening of the streets, as well as the fact that with such regulators a vastly better individual service would be given than at present.

In a small way a tendency is developing towards pushing gas into street mains at higher pressure than what we call the ordinary. In several instances that I know of, and that no doubt will occur to you, a blower or pump creates a pressure on the mains higher than the holder pressure. Long Branch (N. J.) forces gas to Red Bank and Spring Lake, using individual regulators to control the service along the line. No trouble is experienced. Johnstown, N.Y., is fed by gas at high pressure from Gloversville, N.Y., a few miles distant. Elizabeth, N. J., feeds Rahway, 6 or 8 miles distant. One of the Boston companies has a fan working directly on the street mains to increase the supply at certain times. New York has a run of 2 miles of pipe, I believe, under about 24-inch pressure. Philadelphia, for a while, forced gas 3 or 4 miles at something over 2 pounds pressure.

These instances, as far as my knowledge goes, work all right, but at only ½ to 1 or 2 pounds pressure. Why should not the practice be extended to 5 or 10 or 20 pounds pressure and become general? In only one instance that I know of is high pressure used. That is at Danbury, Conn., where gas of 30 to 35-candle power has, for several years, been pumped by a compressor under 40 pounds pressure through a 2-inch wrought iron pipe a distance of some 4 miles, to the town of Bethel, where it is distributed (through a regulator from receiving tanks) in the ordinary manner to the extent of several million feet per year. Is there any particular reason why we should in general continue to deliver at precisely the same rate and pressure that obtained 50 years ago?

I have given you as above my ideas on the matter, informally and in general, chiefly in the way of suggestion, and unfortified with the facts, the detail and the figures that I would have liked. I trust that your discussion of the topic will round the matter out far better than I have done.

Discussion.

The President—Mr. Shelton's papers always provoke discusssion, and I am sure this one will be no exception to the rule. The matter is now before you. Shall we hear from Mr. Butterworth?

Mr. Butterworth—At Columbus four or five years ago we took up this very same question of making a radical increase in our street main pressure. Rather than invest a large sum of money in fortifying and strengthening our distribution system, so as to carry a higher pressure to the outskirts, we attempted to do so by the use of a governor, in the way suggested by Mr. Shelton, but we did not succeed in carrying the pressure as high as he suggests. Then we thought of doing it by weighting the holder. I took the matter up with holder builders and discussed it with them, and they seemed to think it would not be best to attempt it. So we abandoned the idea and spent a lot of money in the street mains. I think, however, that holders could be weighted with safety. I know that Mr. McDonald, at Louisville, weighted his holder for natural gas distribution by loading it with brick all over.

The President—What pressure did he get at Louisville?

Mr. Butterworth—I think there was an average pressure of 9 or 10 inches at the consumers' meters.

Mr. Runner—I have nothing to offer on the subject of pressure, but I have had some experience with the wrought iron pipe and cement joints of which Mr. Shelton speaks. We have a wrought iron pipe that was put down 33 years ago. It was coated with tar at the time it was laid, and this season we found it in as good state of preservation as it was the day it was originally buried. With cast iron pipe laid with cement joints (and a sufficient number of lead joints to give room for contraction and expansion) we have not had a leaky joint up to this time, and we have so laid them for the past 10 years. The pipe that was laid previous to this with lead joints is causing us constant trouble

and annoyance. About every two years we have to get down to every joint and caulk it up. We have kept our unaccounted for gas down to 5.75 per cent. of the gas used.

Mr. Gimper—I know we would all like to distribute gas under higher pressure if we could do it; but the difficulty is we have our holders and we cannot increase our pressure very easily. It is quite an easy matter to put weights on top of a holder, but there are several objections to doing so. My Company would be glad to do it if it could.

The President—Can Mr. Lynn give us some information on this subject?

Mr. J. R Lynn—I have never made any investigation to find out what the loss of candle power was. At one time I did possess some information as to the deposit of hydrocarbons in Pintsch gas but have forgotten just what it was. Of course Mr. Shelton does not propose to compress to anything like the pressure that is placed upon the Pintsch gas mains. In one instance in my experience we had about 1½ miles of 2 inch wrought iron pipe running up to the depot and found that our leakage averaged between 25 and 30 per cent. each month. Of course considering that as the leakage per mile of main it would be a very considerable item. It would be natural to suppose that, if we increased the carrying power of the mains by increasing the pressure at the same time, as Mr. Shelton has stated, we are also going to increase the leakage in the same proportion.

Mr. Elbert—Decreasing the size of the main and increasing the pressure, thereby increasing the velocity of the gas, would in my opinion cause a good deal of naphthalene in the pipe. Prof. Lowe, who in Los Angeles, Cal., sold gas under that system with 8 or 10 inches pressure was troubled in that way. Whether that would happen with coal gas I cannot say. He was making a straight oil and water gas, using no coal. He had naphthalene and he could not get rid of it. That was in a warm climate, too.

Mr. J. A. Mayers—I do not think we can draw any analogy between gas and water in respect to its distribution under high pressure. With water we generally have a vessel large enough to receive it, and there is no danger in the results obtained from distributing water under pressure. Whereas, if gas, when being distributed under high pressure, is allowed to escape, it would soon create a condition which might prove very disastrous. The conditions are very different and cannot possibly be made to compare any more than can the discharge of gas from pipes when being sold be compared with other gas; the one tending to rise upward and the other downward. The danger arising from gas under heavy pressure is very great. It is very much more difficult to control, when being distributed under heavy pressure, because of the large number of regulators which have to be looked after, than when regulated at the station. The possibility of delivering gas at a cheaper rate when under pressure is questionable; and I do not think it is advisable because of the increased risk occasioned by increased pressure in the volume delivered. Under ordinary pressure leaks are readily detected, and it would take a longer time to permit an amount of gas to escape which would be dangerous.

Mr. Ferrier—I wish to ask Mr. Shelton if he employed means similar to those employed by the natural gas people; that is to say, a series of feeders at high pressure, and then a series of low pressure feeders, which would increase the number of regulators necessary, and might be a more economical distribution than by having individual governors at the houses.

Mr. J. R. Lynn—A case which has been considered in comparison is that of natural gas. We must bear in mind the fact that if there are any ingredients in natural gas which one would desire to retain in order to give primary illuminating power, they would have already been precipitated into the earth before we could deliver them in the pipe; whereas in distributing artificial gas under the same pressure we would have our precipitation at the point of comparison, or along the pipe in some place under pressure. In natural gas all the pressure you have is the pressure that you start with.

Mr. Doherty—I have been interested in this for a long time, but did not have the moral courage to bring it out because I could not satisfy myself about it. I am glad Mr. Shelton has brought it out; but I hope the real engineering features of it will not be lost sight of, as they seem to have been so far. One of the first matters which must appeal to us is, "How much volume we gain by distributing the gas under high pressure?" Our pressure generally is about ¼ of a pound; to double that volume we would have to increase it to ½ pound; and at 2 pounds we would have 4 times the volume we had at ¼; at 8 pounds we would have 8 times the volume; at 32 pounds, 16 times the volume. I do not believe Mr. Shelton anticipates going any higher than that?

Mr. Shelton—It is a question of choice.

Mr. Doherty—Then at 64 pounds we would have 24 times the flow; and at 128 we would have 32 times the flow. I thought all along that Mr. Shelton had something up his sleeve and did not care to go against it. According to Pole's formula for increasing the volume of gas by increasing the pressure he gets at 128 pounds 32 times the initial flow, while an increase of pipe from 1 inch to 4 inch would also increase the flow 32 times without raise of pressure. Apparently, if we are going to accept Pole's formula, the volume distributed and delivered would not be any greater than by a 4 time increase in the diameter of the pipe. But we have to face another thing, and that is that Pole's formula is not applicable to high pressures, nor is it applicable to very low pressures. Another thing we must consider is the density of the relatively smaller volume which the gas will occupy after this compressing. That is one thing that I want to see settled by someone who knows more about it than I do. That is, what figures are we going to take to compute the size of pipe necessary to equal certain pressure? If we take the figures which are given us by the formula which we generally use for gas distribution, or if we take figures on natural gas distribution, which come very high, it is surprising what an increase of gas we get at high pressure as compared with the assumption that the increase of four times the pressure would double the volume. Another matter in connection with this ought to be considered. Mr. Butterworth has probably forgotten what he and I considered at Columbus at one time, when I wanted to run a small wrought iron pipe inside of a 10 inch pipe. The street was asphalted and every street running that way already had a pipe in it, and we did not like to parallel any other pipe. I wanted to run a wrought iron pipe right through this 10 inch pipe, and, when striking an obstruction, like a valve, we would bring it outside of the pipe, around the obstruction and back into the pipe. In this way we could use our low pressure main, and would not have to tear up the street except where we struck an obstruction of some kind. I think the most feasible way to strengthen our present distribution system would be by running a smaller pipe right inside of our large gas pipes. As far as regulators are concerned, I do not think we need object to them. In fact I believe now most of us could afford to buy a regulator and put it in every house, and set it so that it would keep the gas at the minimum pressure. What we want is a uniform pressure no matter what that pressure may be. I do not think that has been given the attention it deserves. I also think that pressure governors ought to be purchasable at $1 each. I estimated we could manufacture them for that when Mr. Butterworth had this matter of distribution at high pressure under consideration. I am not a bit afraid of explosions. The natural gas people are not troubled about explosions in their system of distribution under high pressure, and I do not think we need anticipate any trouble. We must find some way of cheaper distribution. It must be either by higher pressure or by the substitution of cheaper pipe than we are now using. The only other engineering feature which appeals to me is the cost of compression. In transmitting air for power, where reheating is not used, I believe the loss is about 80 per cent., so that only 20 per cent. efficiency is retained—that is, in transmitting it any distance where you lose the sensible heat by compression. The loss is figured generally at about 80 per cent.—10 per cent. by the friction in compression, and the other 70 per cent. is doubtless loss in heat. You are generating that heat, but it cannot be put to useful work.

Mr. Jenkins—What pressure would you put on that 2-inch pipe?

Mr. Doherty—Whatever pressure was necessary to distribute the gas for that district and maintain the pressure. In other words, we would run our compressor so as to maintain our pressure at the end of the main pipe. If we were going to dig a ditch, and if the pipe did not represent such a high total cost, we would have then thought it advisable to put in a low pressure main. We thought we could avoid tearing up the asphalt pavement, but the plan received no encouragement from Mr. McMillin. As we all know from experience, when we propose to depart from recognized methods we are very apt to be pooh-poohed at; but, nevertheless, we have to face the problem of the cheaper distribution of gas.

Mr. Wheeler—I think we can get a great deal of valuable information from the experiments at Danbury, Conn., which is about 20 miles from where I was born. With a 2-inch pipe, 4 miles long, they never had any trouble with naphthalene nor condensation, or have they had leakage. I forget how many million feet of gas went through it per year, distributed at ordinary pressure. It has proved to be a very good thing. I do not see why a great many gas companies which are going to stretch out any great distance cannot do the very same thing. I do not think the cost of distribution would be over one-third as much as it

is now. The interest on the investment is very much less I believe the leakage would be reduced at least one-half at 40 pounds pressure. I do not think there will be any trouble from condensation, nor any from naphthalene if the gas is properly made and managed in the works. I think the time is coming when we are either going to do that, to get the gas into the outlying districts of our cities, or else adopt the plan which Mr. Doherty suggests.

Mr. J. R. Lynn—The loss by naphthalene would probably not be the only source of loss to be considered in distributing gas under high pressure to great distances. There would also be the loss from the liquefying of the hydrocarbons and their recovery in the drips. That is a thing we would fear just as much as any naphthalene that we might find. One note in Mr. Shelton's paper that I am very glad he made is the reference to the coating of wrought iron pipes. Some one asked me the other evening what we were doing with our water gas tar. I had occasion to take up a section of wrought iron pipe which had been put in several years ago, and had been coated with water gas tar, and I think if we cannot do anything else with our water gas tar we can use it to great advantage in coating any wrought iron pipe that we may place in the ground. It is certainly a very good preservative. That pipe was laid in sandy soil, where wrought iron pipe would naturally deteriorate to a great extent without any coating.

The President—Will Commissioner Barker tells us whether anything has come under his supervision, or under that of the Board of Gas and Electric Light Commissioners of Massachusetts, on the subject of distributing gas under increased pressure?

Commissioner Barker—I think the practice in Massachusetts is the general practice with reference to pressure in distribution. I am not aware of any attempt to distribute under other than the ordinary pressure—barring the single instance to which Mr. Shelton has referred in his paper; and that is done through only a comparatively short length of pipe.

Mr. Baehr—Our Company (Milwaukee) had one experience in distributing gas under pressure, but only for a short distance. The south side of the town was connected with the works at that time by only one pipe through Jefferson street, and the standpipe was connected with the street main system by an 8-inch connection. The pipe itself was 24 inch. Before laying a new river pipe they had taken out the old one, and as the Southside supply naturally had to be kept up, we forced gas over there under a pressure of 20 to 30 inches. The distance in pipe through which that pressure was maintained was probably from 1,200 to 1,500 feet. I do not know of any instance of leakage due to that pressure. Of course that pressure was not as high as Mr. Shelton anticipates in his paper. One other point in connection with this question of higher pressure which should be considered, is whether, in a street where they are to have a permanent pavement, it would not be better to have a main on each side of the street, or one main pipe under the asphalt on one side or the other, rather than in the center of the street. A great many companies have only one pipe under the pavement. The question at once occurred to me whether it would pay to fix up that extra pipe to stand the higher pressure, rather than to lay two new pipes, one on each side of the street. In the downtown district it would be very expensive work to lay a new main on each side of the street, and would cost more than to take up each joint and put on a sleeve such as Mr. Shelton suggests. In the residence portion of the town, where you have a 6-inch pipe under the asphalt, I know, from our past experience, that we could lay a 6 inch pipe on one side of the street and a 4-inch on the other just as cheaply as we could dig up at every 12th foot of the present pipe. That might be a point to be observed in the future in streets that have been asphalted or paved with permanent pavement, where the engineer is in doubt whether to use two lines of mains or one. I think two lines of main are preferable to one primarily on account of the leakage, and because we can have a great deal easier connections with the services.

The President—If there are no further remarks on this subject Mr. Shelton will reply.

Mr. Shelton—A little bit of fact is worth a heap of theory. Before closing the discussion I want to speak rather more in detail as to what is *being done* at Danbury in the way of high pressure distribution. I prepared my paper in the short time to which I was limited, and had not time to go into the subject fully, but expecting that my suggestion would be more or less criticized, and would be met with objections and statements to the effect that the idea is wrong, that it cannot be done, and that it is foolhardy to consider such a scheme, I thought it would be as well to become acquainted with just what was being done in high pressure distribution, for I made up my mind that, rejecting the comparatively low pressure of ordinary distribution (say $\frac{1}{4}$th or $\frac{1}{10}$th of 1 pound steam pressure), I would suggest and figure upon a matter of 10, 20, 30 or 40 pounds pressure. The only instance of this that I knew of was at Danbury, Conn. I made it a point to go there last Saturday before coming here, so as to be personally able to say that I had seen high pressure distribution under such a system as I have described. I was pleased to find that the system was there considered so old that they had ceased to give it any further thought. It has been in use there not only for 2 or 3, but for 5 and 10 years. Mr. Edgerton, the Engineer who installed it, is not a man who allows himself to be bothered by precedents. He proposed to distribute at high pressure, irrespective of whether it was "according to Hoyle" or to customary practice. A number of engineers with long strings of initials to their names, and of the highest standing, told him it could not be done; that naphthalene would kill it; that leakage would kill it; that the pressure was too great; that the cost would be a barrier; that the pipe would rust out; that everything else would happen. But Mr. Edgerton went ahead and *did* it, and is doing it to his entire satisfaction. He told me that the installation cost him roughly about one half the cost of an ordinary main reaching that distance; and that he secured about $2\frac{1}{2}$ times the delivery per hour through the high pressure system. In other words, he had twice as much service out of the small pipe, and it had only cost him half as much. They have been operating it year in and year out. They pay no attention whatever to it beyond lubricating the regulator that cuts down the gas pressure. There is a compressor in the gas house at Danbury where the gas is made which forces the gas as made into the small 2-inch pipe which goes across country. That pipe leads into a stationary tank which is filled with gas up to 40 pounds pressure. When that is filled they stop pumping. Twice in 24 hours they have to start the compressor up again to re-charge the tank. It takes a couple of hours to do it. They have no outlying holder; they have nothing to look after, except to go to that tank once a week and lubricate the valve. That is the sole attention required. I think a great feature in such a system is the absence of bother with the other end of the line. Everything is worked from the initial pumping station. I think that people who have to supply gas to a far distant point, say 3, 5 or 8 miles away, will find the required investment very much less than the old way, the efficiency just as high and the service perfectly satisfactory when working on these lines. At Danbury they have no condensation to amount to anything. They put in drips along the line as a matter of precaution; and they go over those drips once or twice a year, but do not find anything. Everything that is condensable is "knocked out" of the gas during compression. They get that in the works. There is none of it in the tanks at the other end. The amount of drip at the works does not amount to a barrel per year. They have had no trouble with leakage. The pipe leaked a little bit at first and they had a check valve to keep the pressure off when not in use. They later made the pipe tight and now let it stand at high pressure all the time. They have had no trouble with naphthalene. They have had none of the theoretical bugaboos that the prophets predicted would crop out on high pressure delivery. They are simply distributing gas at a distance of 4 miles, under 40 pounds pressure, and are perfectly well satisfied with the results. They would repeat the proposition immediately if they were going in another direction. I presume it will surprise you if I tell you that yesterday morning I saw another plant which was distributing daily scores of thousands of feet of gas through 30 odd miles of main, the furthest point being 8 miles from the station, the trunk line being but a 2-inch pipe. The whole of the gas goes through that 2 inch pipe. The reason is that they have 200 pounds of pressure back of it. That simply shows what you can do when working under pressure. It shows what efficiency, capacity and delivery can be attained. That plant is the Pintsch plant in Chicago, from which is supplied the equivalent of a third of a million feet per day of ordinary gas. They have 4 compressors working all the time keeping the pipes full at say 200 pounds pressure. At the other ends of the lines there are tanks and regulators which cut the pressure down from high to low, and do it perfectly well. At Danbury the regulator from the receiving tank cuts the pressure down at one drop from 40 pounds to 3 inches. They have a pressure record kept in the ordinary fashion. I looked over the runs for a year. They are just as good as the pressure runs that we get in ordinary gas works. They are not straight runs—I never saw any such anywhere—but they do not vary any more than ordinary pressure registers show. I think the experience at Pittsburg on natural gas is conclusive evidence that *regulators* are all right. The Welsbach people who put out thousands of them say they work perfectly well. They do not give any more thought to regulators than they give to the dependability of valves or any other such appliance. I did not

mean to compare the delivery of gas to the delivery of water except in a general way. I know that no direct parallel is to be drawn. I refer to the general fact that almost every fluid—liquids, gases and everything else—is delivered under high pressure, and large capacity is thus secured from small tubes. In answer to Mr. Ferrier I would say it would be my desire, in the adoption of such a distribution system, as far as possible, to have the local distributing mains low pressure, running a high tension feeder to the district, and putting on a district governor to reduce to the low pressure local system; but along the high pressure lines of such system I would not hesitate to put in individual house governors. The cost of compression and delivery through a few miles of pipe I think you will find, including interest on the investment in machinery, the power and the repairs, will fall within 2 cents per 1,000 on a long distance delivery. The extra attending labor is practically nothing.

Mr. Witherby—I would ask the size of the receiving tank at the place where you estimate the daily consumption, and in which this high pressure gas is stored.

Mr. Shelton—The receiving tanks at Danbury are 6 feet in diameter and 30 feet long. There are two of them. There is a valve by which they can switch off either while the other is being opened or fixed. I might add that the volume of business is about 5,000,000 feet of gas per year, and that Mr. Edgerton's statement to me was that he could just as well reverse the situation and make all his gas at Bethel (a town of 3,500 or 4,000 inhabitants) and deliver the gas from there back to Danbury; in other words, the 2-inch pipe and the compressor would just as well supply gas for a town of 20,000 as for a town of 3,500; or that a 2-inch pipe and a compressor, costing $700 or $800, would take care of several times the amount of business he has had occasion to handle thus far.

Mr. Witherby—If that is a success it would give give gas men cheaper storage. It looks to me as if the plan would bear investigation.

Mr. Shelton—I quite agree with Mr. Witherby that on the lines discussed here is the opportunity and promise of increasing consumption and reducing cost, as the Danbury people have done. We know that the price of gas has gone down steadily year by year; and we know that we must reduce our investment if possible, especially in street mains. I firmly believe that the time is coming, and is not far distant, when high pressure distribution will be very common, and, indeed, the natural thing.

Mr. Wheeler—Mr. Shelton has just taken the words out of my mouth as to the situation at Danbury. Mr. Edgerton made the statement to me that he could just as well supply Danbury, or a city three or four times as large, from Bethel, as to do what he is now doing. I think Mr. Shelton mentioned everything in connection with that undertaking except the fact that there is no drop in candle power, or no more than there is in distributing gas around the outskirts of our city.

On motion of Mr. Wheeler a vote of thanks was passed to Mr. Shelton for his very instructive and interesting paper.

The President introduced Mr. Irvin Butterworth, who read the following paper on

VITRIFIED CLAY PIPE INSTEAD OF IRON FOR GAS MAINS.

The idea of using vitrified clay pipes instead of iron for gas mains did not originate with the writer. It was proposed to him by Mr. Henry L. Doherty, President of the Madison (Wis.) Gas and Electric Company. He afterwards brought it to the attention of the President of this Association, who requested me to prepare a paper on the subject for this meeting, the author of the idea having modestly declined to be the author of the desired paper thereon. I have accordingly consented to bring the matter before you to the best of my ability, this being the second time that I have served, on an occasion of this kind, as Mr. Doherty's "Boswell."[1]

The proposition that ordinary vitrified clay pipes, similar to those now commonly used for sewer construction, can be readily substituted, with great advantage and economy, for wrought and cast iron pipe for gas mains, appears, if not when first presented, then upon due investigation, to be entirely correct. While its correctness cannot as yet be proven by the citation of any examples of the successful use of vitrified pipes for gas mains, because such pipes have not as yet, to our knowledge, been employed, even experimentally, for that purpose; yet the apparent objections to the proposed system, that probably occur to some of you at first thought, disappear upon due consideration of the conditions to be met and the qualities of vitrified clay pipe.

1. See report of "Proceedings," Ohio Gas Light Association. "Still Another Purifying Box," Am. Gas Lt. Journal, Mar. 28, 1898: p. 494.

The suitability of vitrified clay pipes for gas mains is due to its possession of the following properties:

1. Cheapness; 2, durability; 3, strength; 4, non-susceptibility to electrolytic action; 5, slight susceptibility to changes of temperature; 6, non-porosity; 7, adaptability to the making of service connections by the use of specials or a small auxiliary distributing pipe of wrought iron.

We will consider these properties in the order named, and in comparison with those of iron pipe.

1. *Cheapness.*—The following table shows the costs per foot of vitrified clay, cast iron and wrought iron pipe at present market prices:

Inside Diameter.	Vitrified Clay.	Cast Iron.	Wrought Iron.
4 inch	$0.04	$0.22	$0.35
6 "	0 06	0.35	0.65
8 "	0.09	0.46	0 98
10 "	0.13	0.62	1 50
12 "	0.17	0.81	1.92
15 "	0.25	1.19 (16 in)	2.50
20 "	0 45	1.62	..
24 "	0.65	2.06	..

Vitrified clay pipes can be had, in quantity, in 4-foot lengths, and with large and strong sockets similar to the bowls of cast iron gas pipe, at approximately the above prices. The 4-foot lengths would, however, necessitate the making of three times as many cement joints in a line of clay pipes as in a line of cast iron pipes of the usual 12 foot lengths. The following is, therefore, a rough but fair comparison of the cost of a mile of 6 inch vitrified clay and cast iron gas mains:

	Fire Clay.	Cast Iron.
Excavating and refilling trench, at 25 cents per foot	$1,320	$1,320
Cost of pipe in trench, at 6c. and 35c. per foot	317	1,848
Cost of making 1,320 and 440 cement joints, at 25c. each	330	110
Total cost	$1,967	$3,278

Saving in favor of vitrified clay pipes, $1,311, or 40 per cent.

For sizes of main larger than 6 inches, the saving would be still greater, being, for instance, in the case of a 12 inch main, more than 50 per cent.

2. *Durability.*—Vitrified clay pipes are even more durable than cast iron. They do not rust or corrode. No chemicals or substances in the earth, foreign or otherwise, seem to attack them in the least. They are practically indestructible, and retain their strength and non-porosity indefinitely. I recently examined a piece of vitrified sewer pipe that had been buried in the earth for 35 years, which, when cleaned, an experienced sewer pipe manufacturer said he could not distinguish, by appearance or any other test, from freshly made pipe.

3. *Strength.*—Vitrified clay pipe, while not as strong as cast iron, is nevertheless amply strong for gas mains; as they do not break or crush when used for sewers, why should do so when used for gas mains? The tensible strength of vitrified pipe, either fire clay or shale, is astonishingly great. Edward Orton, Jr., Professor of Ceramics at the Ohio State University, recently made some careful determinations of the tensile strength of vitrified clay pipe. He found that ordinary single-strength, 6-inch, vitrified fireclay sewer pipes, with walls ⅝ of an inch thick, withstood an internal hydraulic pressure of from 90 to 120 pounds per square inch; while 6-inch, vitrified shale pipes withstood from 140 to 180 pounds, one piece not bursting even at the latter pressure. Twelve-inch, vitrified shale pipe, with walls 1¼ inches thick, have withstood an internal pressure of 220 pounds. A 2-foot length of 4-inch vitrified, fireclay pipe, selected at random, with walls ½-inch thick, was supported at both ends, and a weight of 2,800 pounds was suspended from the middle of the pipe before it broke. Vitrified clay pipe may be brittle, as are also cast iron pipe, and like them can be easily broken by a sharp blow, such as they would never receive when in use as gas mains; but they are extremely strong, and do not readily break under a steady strain, such as they might be subjected to when buried in the earth. The difference between them and cast iron pipe in this particular is not great, and the advantage is only slightly on the side of the cast iron.

4. *Nonsusceptibility to Electrolytic Action.*—Vitrified clay pipes are not in the least degree liable to injury from electrolysis; whereas, as is well known, the electrolysis of iron pipes has become a most serious matter.

5. *Slight Susceptibility to Changes of Temperature.*—The relatively high coefficient of expansion of iron constitutes a serious objection to the use of this material for gas mains. Iron mains frequently break, and their joints generally leak, on account of the excessive expansion and contraction of the pipe, due to changes of temperature. On the other hand, the expansion and contraction of vitrified clay pipes,

buried to the usual depths of gas mains, would be very slight indeed, and in fact practically nil. The following is a table of the coefficients of expansion of the materials named:

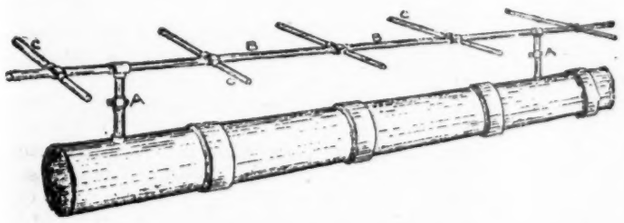
Steel	.0000068
Cast iron	.0000062
Glass	.0000039
Firebrick	.0000023
Common brick	.0000009

Although the coefficient of expansion of vitrified clay has apparently never been determined, it is safe to assume that, inasmuch as it partakes more nearly of the nature of common brick than of glass, its coefficient of expansion is no higher than the average of the coefficients of these two materials, or say only one third that of cast iron. Substantially this view is held by Prof. Orton.

The practical and economic advantage that vitrified clay gas mains would have over iron in this particular need not be dwelt upon here.

6. *Non-Porosity.*—Vitrified clay pipes are, except possibly at enormous pressures, absolutely impervious to gas, while cast iron pipes are more or less porous at ordinary gas pressures. The vitrified clay pipes subjected by Prof. Orton to 180 pounds of internal hydraulic pressure showed no trace whatever of sweating.

7. *Adaptability to the Making of Service Connections by the Use of Specials, or by a Small Auxiliary Distributing Pipe of Wrought Iron.*—It is probable that a successful method of tapping vitrified clay mains for services, and of connecting the services to the mains, would soon be forthcoming; but in laying new mains, especially the smaller sizes, it would probably be best to place a tee special in the line in front of each building lot, with a small side opening, pointing upwards, to receive the service pipe when needed and to remain plugged until then. Such specials for 4 inch, 6 inch and 8-inch pipe would cost only about 18, 27 and 40 cents each, respectively, and larger sizes in proportion. They would not, therefore, appreciably increase the total cost of the main, and the slight increase would not exceed the cost of tapping an iron main for an equal number of services. But it may be found or considered preferable, for the larger sized mains particularly, to place such specials long distances apart, say at street intersections only, and connect them with a small, say 2 inch wrought iron pipe, placed a short distance and immediately above the clay pipe, and from which the various services would be taken, all as illustrated in the accompanying sketch.



This would obviate the necessity of specials in front of lots, or the tapping of the main. By placing stopcocks at the points *A*, and having suitable seals at proper intervals in the main, any portion of the main could be quickly isolated for tests or repairs, without interrupting for a moment the flow of gas in any of the houses supplied from it.

All things considered, there really seems to be no reason why vitrified clay pipes cannot be used, with satisfaction and great economy, for gas mains. There would appear to be no difficulty in making good, tight joints with cement, as the bowls can be made exactly like those of cast iron gas pipe, with plenty of strength to withstand the caulking in of the jute or other packing. We all know of gas plants whose cast iron mains are laid with cement joints that do not break nor leak beyond the normal rate; cement joints can surely be successfully used on pipe of similar shape to the iron, and that expands and contracts only one-third as much.

Of course the vitrified clay pipe must be selected and laid with care, but not more carefully, as it seems to me, than cast iron pipe, which is almost as nearly non-elastic, and which needs a firm and solid bearing throughout its entire length. The bottom of the trench should be scooped out to conform to the shape of the clay pipe, the earth should be thoroughly tamped around it, and a thin plank should be preferably laid over it to protect it from puncture by picks, etc. Lay the vitrified pipe as carefully as you lay the cast iron, and the breakage due to settlements will be no greater, while that due to expansion and contraction will be less, as will also be the leakage. It may be found best also to to use "ring" pipe without sockets, and employ a pantaclinal, pitch, or other flexible joint. In any event, the possibilities for the reduction of the construction accounts of gas companies by the use of vitrified clay pipes instead of iron for gas mains seem too great and promising to be despised.

Discussion.

The President—You have listened to a very novel, interesting and suggestive paper. Is there to be any discussion on the subject?

Mr. Shelton—Just to start the ball rolling let me say I think we ought to thank Mr. Butterworth, and for several reasons. First, because of his good nature in consenting to be a stool pigeon for his associate; and, second, in being willing to stand up (like myself and others) and receive the objurgations of some who object to novel ideas. It does take courage to do that at times. I have been through it! But seriously, I think Mr. Butterworth ought to be thanked for having brought out in practical shape a suggestion which is well worthy our consideration—even if it is in opposition to my own scheme. I am proposing to use smaller tubes and so save expense; he proposes to get right down to the bottom of economy, and to use cheap earth tubes! There is one point in which I do not agree with Mr. Butterworth, and that is where he makes the statement that "Cast iron pipes are more or less porous at ordinary gas pressures." I cannot make myself believe that ordinary cast iron pipe is porous under any pressure that we ordinarily put on it. I have seen half a dozen lengths of pipe packed full of gas under very heavy pressure, which remained just that way for weeks, yes, for months. If there had been any porosity that gas would have worked through, and the pressure gauge would have shown a gradual fall in pressure. But the pressure stayed to the end as it was at the beginning, even fluctuating from day to day according to the temperature and the contraction and expansion inside; thus showing the absolute tightness of the pipe at that pressure with gas. The detail is a small one, but I did not like, by not mentioning it in passing, to let that statement go unquestioned. It seems to me the principal objection to the use of clay pipes would be their greater liability to breakage, under conditions of long span, occasioned in street work by sewer people, in laying conduits, and by other contractors working in the street. While by care and watchfulness, and by properly going over them in the first place, and with caution, that trouble can be very largely reduced, still I think that is one of the practical points that will have to be somewhat carefully guarded against. A short time ago, in the East, a proposition was made to manufacture glass pipe. I do not understand that anything was done with it, except to "Put the company upon the market." Glass is, of course, a perfect protection against electric currents; it is clean, it is very strong, and, with proper machinery, a low grade could be made comparatively cheap. The service connections that I proposed as usable with that I imagine would also apply to sewer pipe connections. I proposed to make a small indentation every three feet along the length of the pipe, with a boss around each, so that with a chisel one could break through the glass and could make a hole for the service connection. One could connect the service pipe at that point by putting in something like a nipple with lock nuts and washers or cement between. I will steal a little bit of Mr. Butterworth's thunder in winding up by saying that I have known clay pipe to be in use for gas down our way for some time.

Mr. Butterworth—I am glad to hear it.

Mr. Chollar—It appears to me that, whether this can take practical shape immediately or not, it would be well for the members of the Association to boom the thing and talk about it anyhow. It might help the pipe syndicate in raising the price! In this connection I would like to ask if anyone present has ever used the fiber pipe that was introduced a few years ago. We had a sample of one length sent to us, but somehow it never was tried.

The President—We have 400 feet of it in use. It put our coal gas plant in a deep hole.

Mr. Chollar—Is it practicable?

The President—I have not examined it for a few months; but the last time it was taken up (which was after it had been there for 3½ years) it was in good shape.

Mr. Chollar—Is it much cheaper than cast iron pipe?

The President—Not much cheaper, on account of the labor.

Mr. Butterworth—It is more expensive than clay pipe. Respecting the point that Mr. Shelton raises as to the porosity of the pipe, I did not, as he well knows, make any great point of that. I simply mentioned that it was as non-porous as cast iron.

Mr. Chollar—Mr. John P. LeRoy, whose office is in the Board of Trade Building, St. Louis, makes a very excellent quality of vitrified pipe for conduit purposes. They are 4 feet long. If any clay pipe would be suitable for gas purposes that would be. I meet him once in

a while, and I think if there is anything in this he would like to take it up, because he is well fitted to manufacture it. Next time I see him I will discuss the matter with him.

Mr. A. B. Eaton, of Chicago, submitted some interesting data respecting tests made by the Robert W. Hunt Company to ascertain the relative crushing and hydraulic strength of samples of three thoroughly vitrified salt-glazed pipes made in the United States. The average crushing strength, respectively, of the different samples was: 10,260 pounds; 12,600 pounds; and 37,650 pounds. The average bursting strength, respectively, of corresponding samples, was 52 pounds per square inch; 112 pounds and 117 pounds.

Mr. Doherty—As to the likelihood of a blow causing injury to a vitrified clay pipe, I originally thought that if such a pipe were struck by a pick the pick would go right through it. I saw a big Irishman the other day attempt to drive a pick through a clay pipe. He hit it a "belt" and knocked a little piece of scale from its outside—the piece was about the size of a thumb nail. At the fifth blow he broke the pipe. He did not drive the pick through it, but cracked or broke it. I have also been told that Mr. John P. LeRoy, of whom Mr. Chollar spoke, has been commissioned to make some vitrified clay pipe for the distribution of water at high pressure. I have written him to ascertain what the pressure was. I have also had access to some other tests besides those given by Mr. Butterworth. The highest internal pressure put on a 6 inch pipe that it stood was 217 pounds. This pipe ran from 180 to 217 pounds, except one specimen which broke at about 90 pounds.

On motion of Mr. Dunbar a vote of thanks was passed to Mr. Butterworth for his paper.

Miscellaneous Business.

The President appointed Messrs. H. L. Doherty, E. E. Eysenbach, and D. R. Warmington as a Committee to investigate the matter of cyanides in connection with the waste products of gas works.

Mr. E. G. Pratt then read the report of the Committee on Securing New Members. On motion of the Secretary, the thanks of the Association were voted to Mr. Pratt for the exceptionally successful work done by him as a member of the Committee.

Mr. Shelton Elected Editor of the Wrinkle Department.

A ballot for the election of the Editor of the Wrinkle Department resulted in the naming of Mr. F. H. Shelton.

Mr. Shelton in acknowledging his election, said: I thank you, gentlemen, for this compliment. I do feel it is a compliment, because I am somewhat removed from your center, which makes it a little more difficult to do the work; but if you feel that I can perform it satisfactorily, it makes it all the more pleasant to realize that I have your confidence. I hope to do it in a way to make your hair curl. I certainly shall do my best, but I ask you to help me by writing out all the wrinkles you can think of the ensuing year, and so make my first year's work easy.

On motion of Mr. Doty, the three reports from the Committee on Isolated Generators for Bench Firing were accepted, and the Committee continued.

Final Resolutions.

The Committee on Final Resolutions presented the following report, which was adopted:

The Committee on Final Resolutions beg leave to report the following:

The thanks of this Association are due to the Committee of Arrangements, who have so thoroughly provided for our comfort and pleasure during our stay in the city, and also have added to the success of the present meeting.

To the Press of Milwaukee, for courtesies shown in reporting proceedings and comments on session and business.

To the First Vice-President, Mr. I. C. Copley, for the careful and thorough manner in which he has carried on the business of the Association.

To the Secretary and other officers for faithful performance of their duties.

And especially to the Committee on Extension of Membership, the handsome list of new members showing the results of their labor.

To the Mayor and citizens of Milwaukee for their cordial reception and warm hospitality shown our members.

And especially to Mr. E. G. Cowdery, Chairman of the Committee of Arrangements, and to his good wife for courtesies extended.

John Gimper,
Henry S. Whipple, } Committee.

The President then declared the meeting adjourned.

Residual Products from Gas Purification.

[A paper read by Mr. William Foulis, C.E., at the last meeting of the Engineering Conference of the English Institution of Civil Engineers.]

The author, who introduced his paper by remarking that it was a series of "Notes on the Recovery of Residual Products from Coal Gas During the Process of Purification," went on to say:

The impurities removed from crude coal gas during the process of purification have, almost without exception, a commercial value, and it is the duty of the gas engineer so to design the apparatus, and to conduct the purifying operations that no salable impurity may be lost, but recovered in a form to yield the highest value. The importance of this subject to the gas manufacturer is best shown by the statement that the amount derived from the impurities removed from coal gas during the process of purification, which were at one time thrown away or destroyed as having no value, is, in this country alone, not less than $7,500,000 per annum, and consequently they are no longer considered merely as impurities which it is necessary to remove, but as residual products, the production of which is one of the aims of the manufacturer of coal gas.

The residual products or impurities which have a commercial value may be briefly described as the liquid hydrocarbons, the nitrogenous compounds, and perhaps also there may be included the sulphur recovered when oxide of iron is used for purification. In this communication the nitrogenous compounds only can be referred to. The most important of these is ammonia.

In a paper read in 1896 before the Institution of Gas Engineers, the author pointed out that of the total amount of nitrogen in the coal used in gas manufacture, only about 13 per cent. was evolved in the form of ammonia, and that more than 50 per cent. of the remainder was left in the coke, whilst in other methods of carbonizing, more especially in shale oil retorts, at least double the above quantity of ammonia per ton is obtained.

In 1897 a paper was read before the Institution of Civil Engineers on the Mond gas producer, in which it is stated that in this method of gas production there is obtained a quantity of ammonia equivalent to 97 pounds of sulphate of ammonia per ton of coal, a quantity four times greater than that obtained in most gas works. That similar results are to be got in the ordinary process of gas manufacture may be doubtful, but something may be done to recover at least a portion of the ammonia which is at present lost.

The method of heating retorts by gas generated in a central producer and conducted in flues to the retort benches, is almost certain to be extensively adopted in the near future. Already practical experiments on a large scale have been made at several works with very encouraging results.

The author's experience leads him to believe that complete success only awaits the overcoming of certain minor difficulties which do not appear very formidable. This method of heating possesses many advantages which it is unnecessary now to refer to; nor the least of these advantages is that it would then be possible to recover the nitrogen in the form of ammonia from a large proportion of the coke. A modification of the gas producer, devised by Dr. Mond, would probably be adopted, and after condensation and scrubbing, the gas would be stored in holders for distribution under constant pressure to the retort settings.

In the paper above referred to the author has pointed out that about 0.027 per cent. of the nitrogen was evolved as cyanogen. The recovery of this impurity has of late years become of considerable importance to the gas engineer, more especially as the use of cyanide for the recovery of gold from refractory ores has so enormously increased the demand for both cyanide of potassium and cyanide of sodium.

When crude gas is passed through moist oxide of iron it combines with a portion of the iron, forming a ferrocyanide. This is perhaps the simplest method of recovering the cyanogen; but it is also the least satisfactory, as it is almost impossible by this means to recover the whole of the cyanogen, or even any definite percentage of it, and also because of the large mass of material that has to be dealt with to obtain the comparatively small quantity of ferrocyanide.

There are at present two methods in practical operation at different gas works for the direct recovery of cyanogen from crude coal gas. In the one method a solution of an iron salt, usually sulphate of iron, is run into an ordinary rotary ammonia scrubber washer, the result being the formation of a ferrocyanide of ammonium—an unstable compound which has no commercial value. The liquor from the scrubber is afterwards treated for the recovery of the ammonia, and also of the

cyanogen in the form of Prussian blue, or of the ferrocyanide of potash or soda.

The author has no practical knowledge of the process or of the results obtained, but it is believed that the cyanogen in the crude gas produced from about 1,000,000 tons of coal per annum is recovered more or less completely by this method.

The other processes referred to is that adopted by the author, and which may be briefly described as follows: Scrap iron is dissolved in hydrochloric acid, forming a chloride of iron. This is afterwards treated with carbonate of soda, and carbonate of iron is precipitated in a very fine state of subdivision. This precipitate is added to a solution of carbonate of soda, in proper proportions, and mixed by stirring in a vessel fitted with a mechanical stirrer. The mixture is then run into a scrubber so constructed that the whole of the liquid is kept in a constant state of agitation.

It is not necessary here to enter into a discussion of the various chemical changes that take place when crude gas, from which all trace of ammonia has been removed, is passed through the scrubber. It is sufficient to state that the ultimate result is a solution of ferrocyanide of soda, together with a small percentage of insoluble ferrocyanide, the amount of which depends on the efficiency of the apparatus to maintain the iron in suspension in equal quantities throughout the liquid. By this means the whole of the cyanogen may be recovered from the crude coal gas, the amount recovered being usually equivalent to 4 pounds of ferrocyanide of soda per ton of coal.

The liquor is run in at one end of the scrubber in the ordinary way. When the percentage of free alkali in the liquor at the inlet end of the scrubber has been reduced to as low a point as possible—usually about 8 per cent. of the total alkali used—the liquor is run off. The mixture may then be allowed to settle, and the clear portion run off, evaporated and crystallized. The insoluble ferrocyanide may be recovered in a soluble form by adding caustic alkali.

As the liquor usually contains a certain quantity of tarry matter it is preferred to evaporate the whole to a dry cake, which can be afterwards dissolved and treated as above described.

Naphthalene Deposits: Their Cause and Prevention.

[A paper read by Mr. Jno. P. Leather, of Burnley, at the 36th Annual General Meeting of the Incorporated Gas Institute.]

The trouble caused by naphthalene deposits presses very irregularly on those responsible for the conduct of gas undertakings. There are probably some who, by experience, know nothing of it; while the problem of how to deal with it has haunted others day and night. Not the least irritating part of the matter is the apparent eccentricity of the naphthalene, which often seems controlled by no law but its own sweet will. Nevertheless experience in all branches of science tends to show that even the most complex problems may be explained as regards their most prominent characteristics by extremely simple laws. So no doubt in the case of naphthalene it is only necessary to carefully examine the phenomena of its formation and conduct under conditions where exact observation and experiment are possible, and its behavior under the more complex conditions of gas manufacture and distribution will be largely understood.

Under the influence of high temperatures, complex organic substances such as coal are decomposed, with the formation of substances of a simpler character. Many of these simpler substances are themselves decomposed if the temperature is sufficiently increased. Therefore, if the temperature at which coal is carbonized be raised, the tendency is to reduce the number of substances obtained, until none are left but those which are not liable to decomposition.

When the distillation is effected at the low temperatures used in the distillation of shale, for instance, a large part of the product consists of hydrocarbons of the paraffine and olefine series. In these the atoms of carbon are combined in open chains, which at a red heat are broken up into simpler forms, with the separation of small quantities of carbon and hydrogen. Of the simpler forms the most stable is marsh gas (CH_4), which with hydrogen adds to the make of gas. Some benzene is also formed, probably by the union of molecules of acetylene.

The same cause which breaks up the open chains of the paraffines also breaks up the side chains of the hydrocarbons of the benzene series, increasing the quantity of benzene at the expense of the toluene, xylene and cumene. The effect of this again is to diminish the quantity of the tar and improve the quality of the gas by adding benzene, which has higher enriching power.

Benzene, however, is not the only closed chain compound which is stable at high temperatures. There are others, of which naphthalene, anthracene and phenanthrene are the most prominent. The two latter, though having their commercial importance in the tar, are too small in quantity, and boil at too high a temperature, to affect the gas. Naphthalene, however, is produced in larger quantity than any other hydrocarbon except benzene and marsh gas; and being in such excess, is able to saturate the gas with its vapor.

In order to understand the behavior which naphthalene may be expected to exhibit in gas, it may be well to reiterate some of the well known laws of mixtures of gases and vapors. If a gas is in contact with a liquid, the liquid evaporates until the gas contains such a proportion of vapor as would by itself give a certain pressure which is known as the vapor tension. This vapor tension varies with the temperature. Given the pressure, temperature and vapor tension of the liquid at that temperature, it is not difficult to calculate the quantity of the vapor which a gas can contain. When dealing with a mixture of liquids of different vapor tensions, the proportions in which the different constituents will be contained in the gas is affected by their proportion in the liquid and their solubility in one another, as well as by the individual vapor tensions. Other things being equal, the substance having the higher vapor tension will be present in larger quantity.

When a gas saturated with a mixture of vapors is cooled, the tendency is for the vapors of highest boiling point and lowest vapor tension to separate out first; but smaller quantities of those with lower boiling point and higher vapor tension separate out at the same time. The gas issuing from a retort is in this condition, giving a distribution of the hydrocarbons between the gas and the tar as shown in Table I., which is taken from a paper by Mr. W. Irwin, read before the Manchester Section of the Society of Chemical Industry, in February last.

Table I.—*Condensable Hydrocarbons in Coal Gas.* (W. Irwin.)

	Boiling Point, Degrees C.	In Gas.	In Tar.	Total.
Benzene	80.4	18.00 lbs.	0.8 lbs.	18.80 lbs.
Toluene	111	6.00 "	0.7 "	6.70 "
Xylene	137–142	0.40 "	1.0 "	1.40 "
Cumene	163–169	0.10 "	0.3 "	0.40 "
Naphthalene	218	0.15 "	13.0 "	13.15 "
Phenol	184	....	1.0 "	1.00 "
Pyridine 90 per cent.	120–140	....	0.3 "	0.30 "
Anthracene	360	....	0.3 "	0.30 "
Phenanthrene	340	....	1.0 "	1.00 "
Higher phenols and various heavy oils	200–400	....	22.7 "	22.70 "
Pitch	....	....	93.0 "	93.00 "
		24 65 lbs.	134.1 lbs.	158.75 lbs.

It will be seen that the benzene and toluene, which have a higher vapor tension at ordinary temperatures than water, are found principally in the gas; while the hyrocarbons having lower vapor tensions, are found chiefly in the tar.

An analysis of the Burnley gas, after passing through a Livesey washer, but before the the extraction of the ammonia, gave the following results:

Analysis of Burnley Gas.

	Weight in 10,000 Cubic Feet.
Benzene	15.80 lbs.
Toluene	5.30 "
Xylene	1.45 "
Cumene and other compounds boiling between 300° and 380° F.	0.32 "
Naphthalene	0.13 "

In the paper above referred to, vapor tensions of the hydrocarbons under consideration were given, as shown in Table II.

Table II.—*Vapor Tensions at Various Temperatures.* (W. Irwin.)

	10° C. mm.	15° C. mm.	20° C. mm.	25° C. mm.
Benzene	48	61.00	79	....
Toluene	..	19.40	..	....
Xylenes 3	..	6.30	..	....
Cumenes 3	..	1.50	..	....
Naphthalene	..	0.03	..	0.08

Taking this table in conjunction either with the figures in Table I. or with the above analysis of Burnley gas, it will be found, on making the necessary calculations, that at 60° F. about 25 per cent. of the gas is saturated with hydrocarbons other than naphthalene, and that only one-tenth of a pound of naphthalene is required to complete the saturation of 10,000 cubic feet of gas. This theoretical calculation is con-

firmed by direct determination. I have made several determinations of the naphthalene in the gas on the works at Burnley. The largest quantity found was at the rate of 0.2 pound of naphthalene per 10,000 cubic feet. The gas in this case had not been cooled below 70° F., at which temperature, calculation shows it to be capable of containing about that amount.

If the gas is subjected to a lower temperature after leaving the works than it has previously experienced, there will be a deposit in the mains. This deposit will consist chiefly of those substances having the lowest vapor tensions; naphthalene in the largest quantity, cumene in less quantity, and xylene in less quantity still. There would be no inconvenience caused by this deposit if it were liquid, as in an undertaking making 500,000,000 cubic feet per annum the quantity would not be more than two or three bucketfuls per week. The difficulty arises from the fact that naphthalene is a solid at the ordinary temperature, melting at about 180° F. and crystallizing in thin plates, which occupy a large amount of space in proportion to their weight.

If the quantities of cumene and xylene in the gas were only slightly greater, sufficient of these might be condensed at the same time to dissolve the naphthalene and let it run to the nearest siphon. But, as already pointed out, they are reduced by the higher temperature at which carbonization is now carried on, and some other method must be devised to overcome the difficulty.

It is evident that in attempting a cure, one or both of two things may be aimed at: (1) The prevention of deposition by withdrawing naphthalene from the gas, so that at the lowest probable temperature the point of saturation will not be reached; or (2) the deposition of the naphthalene in a liquid form by adding something to the gas to cause the deposit to assume that form.

Various modifications of plant and means of working have been claimed as cures for the naphthalene trouble. Those which consist of variations of the condensing plant will be often found of local value only. When attempted to be applied elsewhere, the different conditions as regards quality of coal, temperature of carbonization, etc., render the methods inapplicable.

If, however, the gas be washed with a liquid which dissolves the naphthalene out of the gas, the possibility of its after deposit is very evidently prevented. It may be suggested that such a washing would deprive the gas of other constituents which give it illuminating power. It is, however, found in practice, as indeed might be deduced from theoretical considerations, that the quantity of benzene and toluene dissolved from the gas is very limited. For instance, in washing gas to obtain benzol, as is done in carbonizing and coke works, by means of creosote oil, it is not found possible to obtain more than 6 per cent. of benzol in the creosote. If the creosote contains much more than 6 per cent. of benzene, the gas will take up benzene instead of losing it.

Of processes which have attracted much notice as cures for the naphthalene trouble the most prominent is that of Messrs. Botley, which has been in use for some time at Hastings. The details of this process are probably familiar to most of the members of the Institute. Briefly it consists of filling the gas just before it leaves the works with an exceedingly fine mist of paraffine oil. The arrangement is well designed and works with great ease, reflecting much credit on its inventors. The mist is of such a fine character that a great part of it is carried through the whole canalization of the district, even to the consumers' burners.

All mists fall if sufficient time be given; and as the spraying apparatus breaks up the oil into particles of varying size, no doubt the larger ones fall first. There is usually a considerable deposit in the first 150 yards of main before the gas actually leaves the works. This is collected and used over again until the specific gravity reaches .850; that of the original oil being .800.

In communications which have been made public by Messrs. Botley, they appear to have been under the impression that this oil had not dissolved any naphthalene out of the gas, and their explanation of its action was not very satisfactory. By the courtesy of Mr. Botley, a short time ago I not only saw the process at work, but was kindly permitted to take a sample of this oil; and on analysis I obtained the following results:

Analysis of Deposited Oil from the Hastings Works Main.

5 per cent. boiling below 212° F., chiefly benzene.
2 " between 212° and 250° F., chiefly toluene.
5¼ " between 250° and 300° F., chiefly xylene.
10½ " between 300° and 380° F., of which nine tenths were cumene or other substances of the benzene series.

About 5 per cent. by weight was naphthalene.

The quantity of this oil recovered amounts to 0.023 gallon per 10,000 cubic feet of gas, which corresponds to an abstraction from the gas of the following quantities per 10,000 cubic feet:

Benzene	0.009 pounds.
Toluene	0.004 "
Xylene	0.011 "
Naphthalene	0.010 "

As the quantity of benzene in Hastings gas is probably not less than 14 pounds per 10,000 cubic feet, the abstraction of less than one-hundredth of a pound cannot have any measurable influence on the illuminating power. It will be seen that the oil has taken out quite as much naphthalene as benzene, although the quantity of benzene in the gas exceeds that of naphthalene more than 1,000 times.

In the distribution of mains there is a further deposit of oil, the quantity of which has not been determined. This also contains naphthalene. The conclusion therefore is that the Hastings process removes, by solution in the deposited oil, about one-fifth of the naphthalene from the gas. This is probably of itself sufficient to overcome the naphthalene difficulty under ordinary circumstances; but if the gas is subjected to an exceptional reduction of temperature, it is evident that any deposit of naphthalene is sure to be rendered liquid by the oil mist still left in the gas.

A comparison of the analysis of the original Tea Rose oil used at Hastings with the oil deposited after use, discloses an interesting fact, which might indeed have been expected from the well known laws of solution of vapors in gas. Tea Rose oil begins to boil at about 250° F., and 50 per cent. of the oil boils below 460° F. The deposited oil only contains about 45 per cent. boiling below 460° F.; and nine-tenths of this portion consists of aromatic hydrodarbons not originally contained in the Tea Rose oil It follows from this that 100 parts of oil sprayed into the gas give up 45 parts in the form of vapor, and absorb 40 parts of benzene and other aromatic vapors from the gas. The addition of these paraffine vapors to the gas necessarily assists further to prevent naphthalene troubles. A considerable portion of them have a boiling point approximating to that of naphthalene. If the gas suffers a reduction of temperature during distribution, these vapors will be partially condensed, and thus serve to keep any deposited naphthalene in solution.

The addition to the gas of hydrocarbon vapors of the paraffine series having a boiling point approximating to that of naphthalene, plays an important part in the process adopted at St. Helens by Mr. Samuel Glover. In this case a portion of the coal is carbonized at a low temperature; and the gas therefrom is mixed, while hot, with the already cooled gas from high temperature retorts. The result may be expected to be similar to that at Hastings. The hot gas containing a great variety of hydrocarbons partly in suspension and partly in the form of vapor, a portion of the naphthalene will be dissolved out in the hydrocarbons condensed from the gas, and the portion not immediately dissolved will, if deposited at all, be deposited in a liquid form. It is, however, simpler to dissolve out the naphthalene at once on the works, and thus preclude the possibility of any trouble afterwards; and I have experimented successfully in this direction during the past six months. Having a scrubber at liberty, creosote oil was pumped through, using the same oil over and over again, until it ceased to take up naphthalene from the gas. Two hundred gallons of creosote will dissolve the naphthalene out of more than 10 million cubic feet of gas. At the time when the experiment was first tried, a number of men had to be employed doing little else than attend to consumers' complaints of stopped services, in addition to which frequently more than 100 lamp services required clearing out per day. On using the creosote, the complaints quickly ceased, only to occur again, however, about twelve days later, when the oil had absorbed about 16 per cent. of naphthalene. On several occasions the oil had been worked up to saturation point, and fresh oil brought into use as soon as the reports of small lights at the public lamps came in. Each time after changing the oil, the stoppages have rapidly been cleared.

Used by itself the oil absorbs benzol from the gas equal to about 6 per cent. of its weight. By adding a small quantity of benzol to the oil before using, this action is prevented. The illuminating power of the gas is taken on the works by a jet photometer every half hour; but no effect has been observed on bringing the oil into use. By using a suitable mixture of benzol with the oil, a ready method is obtained of enriching the gas to any required extent, and variations of illuminating power are partially neutralized.

After use the oil is pumped into a still; the benzol and light oils being distilled off by means of steam. By further application of live steam, the naphthalene can also be distilled over and added to the tar

in the tar well. The creosote left in the still can then be used over again, mixed with the light oils.

I have tried various kinds of oil for the purpose. Prices and local circumstances may cause one kind of oil to be preferable to another, and the details of working may be varied. In any case the cost is not very great and the trouble is slight, the whole system working almost automatically.

Instead of passing the oil through a tower scrubber it would be preferable to use a washer-scrubber, which could be kept in efficient work by a very small stream of oil. The gas would then come into contact with oil containing naphthalene first, and finish with fresh oil. In this way the oil could be worked up to saturation point, and thus absorb the whole of the naphthalene from a larger quantity of gas.

In conclusion, I must express my indebtedness to Mr. W. Irwin, at whose suggestion I first tried the method I have described, and to my Works Analyst, Mr. F. W. Harris, for his assistance in the various analyses.

Since writing the foregoing, I have had my attention called to the able and original paper brought before the Institute two years ago by Messrs. Young and Glover, in which they recommend the extraction of naphthalene from coal gas by methods very similar in principle to that indicated in this paper. As I have already stated, the idea was suggested to me by Mr. Irwin, who I believe was the first to extact the condensable constituents of coal gas on a commercial scale, and who has had long experience in their extraction both at carbonizing works and at modern coke ovens. This experience proved the effect of high temperatures on carbonization to be as I have stated. It was simply a matter of arranging the rate of his run of oil as to whether he extracted only the heavier or the whole of the condensable products of the gas. He, of course, was able to bring his experience to bear in testing the actual quantity of the various products of condensation in the gas; this being absolutely necessary for placing the process on a practical footing. It is also a side of the question which previous experimenters have not touched upon, if indeed we except Dr. Leitner, whose paper has recently appeared in the *Journal of Gas Lighting*, but whose figures relative to the amount of naphthalene in coal gas are much too high—being far above what its vapor tension would allow if it were the only condensable constituent of the gas. I simply make this statement to show how we arrived at the process independently, and also brought the same to a practical conclusion.

Correspondence

[The JOURNAL is not responsible for the opinions expressed by correspondents.]

An Anomaly in Incandescent Electric Lighting.

NEW YORK, June 20, 1899.

To the Editors AMERICAN GAS LIGHT JOURNAL:

As the following question appears to be of interest to the gas fraternity, I have asked it through the medium of your paper rather than through one of the electrical journals, and hope it will receive an answer from an electrical engineer.

The question is, "Whether it is not more economical to run incandescent lamps at higher voltages than they are now intended for, even if by so doing the life of the lamp is shortened 50 per cent. or even more?"

In Sylvanus P. Thompson's "Elementary Electricity," 1898, p. 462, is given the following table of data regarding a 10-candle, 50-volt lamp, run at different voltages:

Volts.	Amperes.	Watts.	Candle Power.	Watts per Candle.	Probable Life Hours.
48	0.77	37.0	8.0	4.3	3,200
50	0.81	40.5	10.0	4.05	1,500
53	0.87	46.4	14.5	3.2	800
55	0.92	50.6	18.5	2.7	480
58	0.99	57.5	25.5	2.2	250
61	1.06	64.7	35.5	1.8	150

It seems fair to assume that the 16-candle lamp will give approximately the same results under similar conditions. In New York the Edison rate for domestic use is generally 20 cents to 15 cents per kilowatt hour, and the cost of 16-candle lamps at retail is, say, 20 cents each. The 16-candle, 115-volt lamp consumes 50 watts per hour or 3⅛ watts per candle.

Assuming the life of the lamp to be 1,000 hours, the current at 20 cents per kilowatt hour, will cost 1 cent per hour; and the lamp, at 20 cents, equals .02 cent per hour, or a total of 1.02 cents per hour.

If the lamp were run at higher voltage, so that the life would only be 500 hours, the cost per hour for current would be increased about 15 per cent, as more amperes would be used at the increased voltage, and the cost per hour for lamp and current would be about 1.19 cents, being an increase in cost of about 17 per cent., while by Thompson's table the amount of light would be increased about 45 per cent., and with a shorter life for the lamp the increase of light runs up to still higher percentages.

It is impossible for me with the data at hand to give the exact cost of the current or increase of light for the 16-candle lamp at the higher voltages, but it seems evident that, where the cost of the lamp per hour is so small, compared with the cost of the current, it is better to sacrifice the lamp if, by so doing, any better results can be obtained from the current.

It would not, of course, be necessary to increase the present voltage, but only to make a lamp for, say, 90 or 100 volts and run it at 115.

I do not believe that this question suggests any improvement in electric lighting, as it must have occurred to our electric friends who are "Smarter'n we be;" but their answer will, I think, be of interest to gas men, even though the question may have never occurred to them.

Yours truly, GAS.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

MR. S. P. CURTIS, formerly of Newark, N. J., has been appointed Superintendent of the New York Suburban Gas Company, Mount Vernon, N. Y., branch.

MR. CARROLL MILLER has been appointed Engineer-in-Charge of the Market street works of the Essex and Hudson Gas Company, Newark, N. J.

A CORRESPONDENT, under date of the 8th inst., incloses the following from Hagerstown, Md.: "The Hagerstown Gas Company has in view the making of some extensive improvements at the gas works. Several thousand dollars will be expended in the construction, and the capacity of the plant will be increased from 150,000 to 300,000 cubic feet per day. The order for the necessary iron work has been given to Messrs. Bartlett, Hayward & Co., of Baltimore. Mr. H. E. Dayhoff, architect, has drawn the plans for the houses to cover the generating and other manufacturing apparatus, and the excavations for the foundations are now underway. Two years ago the Company had about 600 consumers, and at the present time the number is over 1,000, with plenty of applications for new services. When the works are reconstructed a considerable concession will be made in the selling rates."

THE Merced Falls Electric Light and Power Company has absorbed the properties and franchises of the Merced Gas and Electric Light Company, of Merced, Cal.

MR. JOHN H. BLAKE, who, if we mistake not, was a brother of the late James Barnard Blake (at the time of his death,[1] which was caused by an explosion in the purifying house of the Worcester (Mass.) Gas Company, James B. Blake was Mayor of Worcester and Superintendent of the Worcester Gas Company), died at his home, 278 Marlboro street, Boston, Mass., the morning of the 5th inst. Deceased was one of the original promoters of the Worcester (Mass.) and the Lawrence (Mass.) Gas Companies. He was in his 91st year.

ACCORDING to the annual report of Mr. W. P. Knowles, Superintendent of the Richmond (Va) municipal gas works, the total output for the twelvemonth amounted to 214,786,000 cubic feet, which was in excess of the quantity sent out for the preceding twelvemonth by 2,763,400 cubic feet. The balance to credit of works, in the matter of receipts over expenditures, is returned at $80,838.21. The number of gas lamps in use on the streets (125 of which are of the Welsbach type) is returned at 1,648.

ACCORDING to the report of the official gas inspector for Minneapolis, Minn., the illuminating value of the gas furnished in the city by the Minneapolis Gas Light Company during the month of June averaged 24.44 candles.

MR. L. D. YAGER, acting as Master-in-Chancery of the City Court, Alton, Ills., sold recently at public auction the gas plant formerly

1. December 18, 1870.

owned by the Alton Electric Railway and Illuminating Company. The purchaser was Mr. D. King, of Boston, who, representing the bondholders, bid $7,000 for the property. The bonded indebtedness amounts to $69,000.

LAST month a very successful series of demonstration lectures on cooking by gas was completed by the Capital City Gas Company, of Des Moines, Iowa. The lecturess was Mrs. Sara Wharton Moore, and the entertainment of the guests was smoothly carried out under the direction of Mrs. E. G. Pratt, the estimable wife of the Company's Manager.

AT the annual meeting of the Burlington (Vt.) Gas Light Company no change was made in the managerial staff.

THE Saturday *Review*, Quincy, Ills., of the 8th inst., had this to say: "Mr. Wm. E. Steinwedell is one of the brightest and best young men Quincy ever produced, and we were hoping that he might retain his residence in this city and add his young blood and marked ability to building up our beautiful city, but it seems that interests of a personal nature have willed otherwise and he has removed from our midst. He goes to Belleville, Ills., as Superintendent of the gas and electric light plants of that city, and we wish to say to the Directors of the Belleville Company, and to the citizens of Belleville generally, that they have made a wise selection in young Mr. Wm. E. Steinwedell, who, from his youth up, has been thoroughly educated, both theoretically and practically, in the business of gas and electric lighting. He comes of one of Quincy's oldest, most prominent and best educated families, and has received an early training that means future success to any enterprise with which the young man is connected. He will prove a valuable acquisition to the society and business community of Belleville, and our loss is their gain. We are truly sorry to have Mr. Steinwedell leave Quincy and its manufacturing institutions, to which his father and himself have been attached all their lives. Our best wishes go with young Mr. Steinwedell, although we shall miss him as a gas light and electric official; as a Turner, of which society he is President, and as an especially good citizen of Quincy; and we speak candidly and earnestly when we say that it is with feelings of real regret that we chronicle his retirement from our city and circle

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THE Binghamton (N. Y.) Gas Company will have the adjoining district of Lestershire thoroughly piped by August 1st.

MR. C. F. LEONARD has been appointed Superintendent of works of the Easton (Pa.) Gas Company.

AT a special meeting of the Conshohocken (Pa.) Gas and Water Company a proposition to increase the bonded indebtedness was adopted.

THE Board of Directors of the Madison (Wis.) Gas and Electric Company have perfected the following organization: President, H. L. Doherty; Vice-President, N. B. Van Slyke; Secretary and Treasurer, W. F. Douthirt; Asst. Secy., Charles R. Riebsan; Manager, John Corscot.

A CORRESPONDENT says that the Boone Gas Company to construct and operate a gas plant in Boone, Iowa, means business. It is capitalized in $100,000, and those chiefly concerned in it are: George D. Roper, Rockford, Ills.; Ernest C. Brown, of New York; A. D. Cressler, of Fort Wayne, Ind.; E. G. Pratt, of Des Moines, Iowa; and Jno. G. Holmes, of Buchanan, Wis.

AT a meeting of the Council of New Rochelle, N. Y., held early this month, the proposition to grant a franchise for the construction and operation of a gas works in New Rochelle by the Westchester Gas and Coke Company was rejected.

A CORRESPONDENT writes that at the annual meeting of the shareholders of the Louisville (Ky.) Gas Company the following Directors were elected: Udolpho Snead, John Stites, H. V. Loving, D. X. Murphy and K.W. Smith. Messrs. Murphy and Smith were chosen to succeed Messrs. George W. Morris and John M. Atherton, who resigned their places. Mr. Morris was identified with the Company for many years, and resigned the Presidency thereof some months ago to become President of the Mutual Life Insurance Company, of Kentucky. Mr. Atherton is in poor health and has retired from active business. He says he does not want to be connected with any interest that will demand much of his time. Mr. Murphy is a well known architect and will make an efficient Director. Mr. Smith is the State Agent of the Mutual Benefit Life Insurance Company. The Directors to represent the city on the Board (about one-fourth of the Company's stock is owned by the city) are W. J. Abram, T. Hunt Stucky, George Gaulbert and John Doerhoefer.

THE proprietors of the Knoxville (Tenn.) Gas Company have put the gross selling rate at $1.10 per 1,000 cubic feet, with 10 cents per 1,000 rebate for prompt payment within 10 days.

THERE is little doubt that the United Gas Improvement Company has secured the necessary three-fourths of the stock of the Hudson County Gas Company, of Hoboken, N. J., which proportion was required to give the purchaser complete control, in so far as the issue of new securities, etc., is concerned. The text of the offer is appended:

"1. All the stock of the local Company is to be purchased at the price of $187.50 per share, or at the rate of 375 per cent., on August 1, 1899.

"2. The stock is to be paid for in cash, upon delivery of the certificates duly assigned to the New Jersey Title Guarantee and Trust Company, of Jersey City, on or before the above date.

"3. Stockholders, however, have the option of accepting for all or any part of the stock so sold and delivered, in lieu of cash, 5 per cent. bonds of a new corporation to be formed to take over all the gas properties in Hudson county, which bonds will carry interest from August 1st, 1899.

"4. Those electing to accept bonds will be entitled to purchase stock in such new corporation at 25 per cent. on its par value, equal in par value to their holdings in this Company, or so much thereof as shall be transferred for bonds of the new Company.

"5. The holders of stock sold for cash will not be entitled to purchase stock in the new Company.

"6. Holders of stock who shall elect to take bonds for all or any part of their stock in this Company will have until 10 days after notice to do so to exercise such option, and with such notice will be given a statement of the amount of stock and bonds that will be issued by the new Company.

"7. Unless accepted by the holders of at least three-quarters of the outstanding stock of this Company, on or before August 1, 1899, this proposition of the United Gas Improvement Company will be withdrawn."

THE same purchasing parties have offered to purchase all of the stock of the Jersey City Gas Light Company, at the price of $250 per share, and all of the stock of the Peoples Gas Light Company, of Jersey City, at $250 per share. We understand that an offer of par has also been made for the stock of the Consumers Gas Company, of Jersey City. The terms of the circular as given above virtually apply to shares of the Companies named in this paragraph.

THE new gas rate at Alexandria, Va. (gross, $1.30, less 10 per cent. for prompt payment) is now in force.

THE franchise for a gas works at Marine City, mention respecting an application for which to the authorities has hitherto been made in the JOURNAL, has been granted. The grant is to last for 30 years, and those chiefly concerned in it are Messrs. Frank D. Jenks and A. D. Bennett, of Port Huron, Mich.; and J. T. Lynn, of Detroit.

ON the 7th inst. the Board of Public Works, Louisville, Ky., refused to grant permits to the Kentucky Heating Company to lay down pipes in certain streets, for which privilege the Company petitioned some time ago. When the Heating Company applied for the permits the application was opposed by the Louisville Gas Company, and the attorneys for both eventually argued the matter at length before the Board of Public Works. A few days ago City Attorney Stone sent an opinion to the Board, in which he took the ground that the permits should be granted. Later on Judge Humphrey filed a written brief combating the points raised by Attorney Stone. The opinion of the Board is as follows: "Acting upon the application of the Kentucky Heating Company to lay down its pipes and mains for fuel and heating purposes in and along the streets and alleys of the city of Louisville, in accordance with an ordinance approved August 11, 1888, and inasmuch as the said Company has admitted that it is furnishing natural and artificial gas for other than heating purposes, same being in violation of the foregoing ordinance, this Board hereby declines to issue further permits to the said Company." The matter will now be taken into the courts for final

(*Continued on page* 95.)

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England—Aug. Siegle, 30 Lime Street, London.

MONDAY, JULY 17, 1899.

(*Continued from page* 94.)

settlement. Meanwhile the Heating Company cannot make any main extensions.

THE following is from the New York *Journal of Commerce*, dated the 8th inst.:

"A meeting of representatives of Buffalo, N. Y., Gas Companies was held in this city on Thursday, at which a combination of the gas interests of that city, exclusive of natural gas, was definitely arranged for. A new Company will be organized, to be known as the Buffalo Gas Company, which will take over the Buffalo Gas Light Company, the Buffalo City Gas Company, the Mutual Gas Company and the Peoples Gas Light and Coke Company, the latter an Addicks concern. The ownership of these Companies has been largely identical for some time. The union of these Companies will be effected in the following way: The Buffalo Gas Company and the Buffalo City Gas Company will be consolidated, and the Mutual Gas Company will then be merged with these. The Peoples Gas Light and Coke Company will remain as a separate corporation for some time, but as the Buffalo City Gas Company owns 90 per cent. of its bonds and stock, which will be turned over to the new Company, the latter will have control. The new Company will have a capital of $16,000,000, of which $7,000,000 will be in bonds bearing 5 per cent. interest, payable semi-annually, $2,000,000 in 6 per cent., non-cumulative preferred stock and $7,000,000 in common stock. Of the bonds, $5,900,000 will be held in trust for the purpose of retiring an equal amount now outstanding of a $7,000,000 authorized issue of the Buffalo City Gas Company. The remaining $1,100,000 authorized for the latter Company will not be issued, while the remaining $1,100,000 authorized for the new Company may be issued for improvements. Of the preferred stock, about $1,710,000 will be used to take up an equal amount of outstanding debentures of the various Companies, while the common stock will be exchanged for that of the present concerns. The balance of the preferred stock will be held in the treasury for the present. It is likely that the Peoples Gas Light and Coke Company will be formally amalgamated with the others at a later date. A. C. Humphreys will be President of the consolidated Company."

The Market for Gas Securities.

For the past week, and without any seeming good reason therefor, quotations for city gas shares showed a marked shrinkage in values, which decline was particularly noticeable in the instance of Consolidated. Closing last week (Friday) at 188¾ to 189, the minimum rate was reached about mid-week, and at noon to-day (Friday) sales were made at 182½ with that figure bid and 183 asked. It is particularly noticeable just now that none of the Companies is making a very hard struggle to secure additional business, although that fact is not to be taken as meaning that the rate war is at an end. Standard common is without change, and Amsterdam common is down about 1½ points. Mutual is nominally 260 bid. It is worth and eventually will bring very much more. While it would be mere guesswork to predict the situation, to a man on the pavement it seems that the "magnates" are not as bold warriors to-day as they were in the budding month of May.

Brooklyn Union is steady, at 142 to 145, and a slight flurry in Peoples, of Chicago, was caused by the announcement that the Ogden Company had decided to bond itself for several millions, some thousands of which were to be expended in extending its business at the expense of the Peoples Company. There is nothing in such talk. Buffalo gas seems to be vieing with Bay State, so far as low level seeking is concerned. The former is 9½ bid, the latter is not in demand, at 2 bid. Lacledes show a hardening tendency, and Syracuse is noticeably better. The market as a rule for outside shares is decidedly on the strong side. U.G.I. Company is 166 bid. We repeat our prediction that these shares cannot fail to go to 200.

Gas Stocks.

Quotations by George W. Close, Broker and Dealer in Gas Stocks.

16 WALL STREET, NEW YORK CITY.

JULY 17.

☞ All communications will receive particular attention
☞ The following quotations are based on the par value of $100 per share.

N. Y. City Companies.	*Capital.*	*Par.*	*Bid.*	*Asked.*
Consolidated	$39,078,000	100	182¾	183
Central Union, Bonds, 5's.	3,000,000	1,000	107½	108½
Equitable Bonds, 6's	1,000,000	1,000	105	.
" 1st Con. 5's	2,300,000	1,000	115	118
Metropolitan Bonds	658,000	.	108	112
Mutual	3,500,000	100	260	..
" Bonds	1,500,000	1,000	100	102
Municipal Bonds	750,000	..	..	..
New Amsterdam Gas Co.	13,000,000	100	34¼	35¼
Preferred	10,000,000	100	58½	59½
Bonds, 5's	11,000,000	1,000	100¼	101
Northern Union, Bonds, 5's.	1,250,000	1,000	95	97
New York and East River..				
Bonds 1st 5's	3,500,000	1,000	109	111
" 1st Con. 5's	1,500,000		112	114
Richmond Co., S. I.	348,650	50	70	..
" Bonds	100,000	1,000		..
Standard	5,000,000	100	118	..
Preferred	5,000,000	100	135	138
Bonds, 1st Mortgage, 5's	1,500,000	1,000	112	114
Yonkers	299,65	500	130	.
Out-of-Town Companies.				
Brooklyn Union	15,000,000	100	142	..
" " Bonds (5's)	15 000,000	1,000	118	119
Bay State	50,000,000	50	2	2½
" Income Bonds	2,000,000	1,000	..	75
Binghamton Gas Works..	450,000	100	40	..
" 1st Mtg. 5's	450,000	1,000	95	98
Boston United Gas Co.—				
1s Series S. F. Trust	7,000,000	1,000	92	..
2d " " "	3,000,000	1,000	68	71
Buffalo City Gas Co.	5,500,000	100	9½	10½
" " Bonds, 5's	5,250,000	1,000	84	85
Central, San Francisco	2,000,000	..	105	..
Chicago Gas Co. Guaranteed Gold Bonds	7,650,000	1,000	104	104¼
Columbus	1,144,700	100	70	75
1st Mortgage	1,207,000	1,000	106	108
Consumers, Jersey City	2,000,000	100	95	.
" Bonds	600,090	1,000	107½	110
Cincinnati G. & C. Co.	8,500,000	100	178	183
Consumers, Toronto	1,700,000	50	230	235
Capital, Sacramento	500,000	50	..	35
Bonds (6's)	150,000	1,000		
Consolidated, Baltimore	11,000,000	100	61½	61¾
Mortgage, 6's	3,600,000	..	..	118
Chesapeake, 1st 6's	1,000,000	..	..	..
Equitable, 1st 6's	910,000	..	..	..
Consolidated, 1st 5's	1,490 000	..	..	112
Consolidated Gas Co. of N.J.	1,000,000	100	21	23
" Con. Mtg. 5's	380,000	1,000	87	90
Consolidated G. & E. Co.'s., Little Falls, N.Y.	90,000	100	..	100
Bonds	75,000	..	..	100
Detroit City Gas Co	4,560,000	50	65	65½
" Prior Lien 5's	4,546,000	1,000	94¼	94½
Detroit Gas Co., 5's	423,000	1,000	95½	96
" Inc. 5's	31,000	100	..	..
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1,000	..	101
Fort Wayne	2,000,000	..	77	88
" Bonds	2,000,000	..	80	85
Grand Rapids Gas Lt. Co.	1,000,000	50	..	..
" 1st Mtg. 5's	1,125,000	1,000	..	.
Hartford	750,000	25	..	220
Indianapolis	2,000,000	..	122	128
" Bonds, 6's	2 650,000	..	105	106
Jackson Gas Co	250,000	50	50	..
" 1st Mtg. 5's	250,000	1,000	96	100
Jersey City	750,000	20	225	275
Lafayette Gas Co., Ind	1,000,000	100	68	70
Bonds	1,000,000	1,000	81	86
Louisville	2,570,000	50	106	108
Laclede, St. Louis	7,500,000	100	54½	55
Preferred	2,500,000	100	95	100
Bonds	10,000,000	1,000	107	108
Madison Gas & Elec. Co.	400,000	100	68	70
" 1st Mtg. 6's	350,000	1,000	102	..
Montreal, Canada	2,000,000	100	200	..
Newark, N. J., Gas Co	1,000,000	..	200	220
Bonds, 6's	4,000,000	..	128	130x
New Haven	1,000,000	25	280	300
Nashville Gas Lt. Co.	1,000,000	50	110	..
Oakland, Cal.	2,000,000	..	53½	55
" Bonds	750,000	..	.	..
Peoples G. L. & Coke Co., of Chicago	25,000,000	100	117¼	117⅝
Peoples Gas Lt. & Coke Co., Chicago, 1st Mortgage	20,100,000	1,000	111½	112
2d "	2,500.000	1,000	104	105
Peoples, Jersey City	500,000	50	215	..
Rochester Gas & Elec. Co.	2,150,000	50	88	..
Preferred	2,150,000	50	118	..
Consolidated 5's	2,000,000	.	87½	90
San Francisco, Cal.	10.000,000	100	74	75
St. Paul Gas Light Co	1,500,000	100	50	52
1st Mortgage 6's	650,000	1,000	82	85
Extension, 6's	600,000	1 000	.	..
General Mortgage, 5's	2,428,000	1,000	80	82
St. Joseph Gas Co	1,000,000	100	42	44
" 1st Mtg. 5's	750,000	1,000	98	99
Syracuse, N. Y.	1,750,000	100	16	19
Bonds	1,612 000	1,000	81	84
Washington, D. C	2,600,000	20	260	265
First mortgage 6's	600,000	..	..	..
Western, Milwaukee	4,000,000	100	99	100
Bonds, 5's	3,830,500	.	106	108
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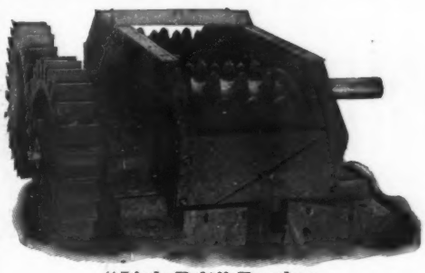

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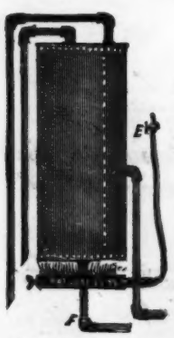

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Clamp Heater to Pipe about 4 Inches away from bottom of Boiler. Always use an independent connection, or regular Gas Stove connection, so as to get a good flow of Gas.

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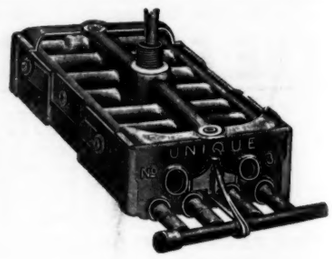

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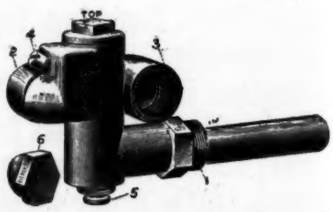

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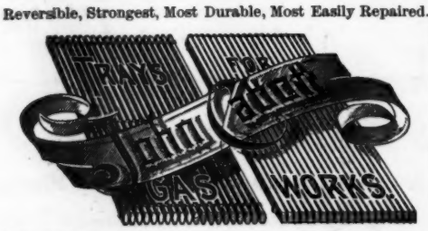

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PRESSURE GAUGE.

For continuous records of **Street Gas Pressure.** Simple in construction, accurate in operation, and low in price.

Fully Guaranteed. Send for Circulars.

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Plans prepared and Estimates furnished at short notice.

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BANK OF COMMERCE BLDG.,
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GAS PROPERTIES PURCHASED.

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MANUFACTURERS OF

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Also, Gate Fire Hydrants with and without Independent Nozzle Valve. All Work Guaranteed.

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Chicago Office, 24 West Lake St. New York Office, 28 Platt St.
St. Louis Office, L. M. Rumsey Mfg. Co., 810 North Second St.

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Ludlow Valve Mfg. Co.,

TROY, N. Y., U. S. A.

Double and Single Gate Valves, ¼" to 72",

—FOR—

Gas, Water, Steam, Oil, Ammonia, Etc.

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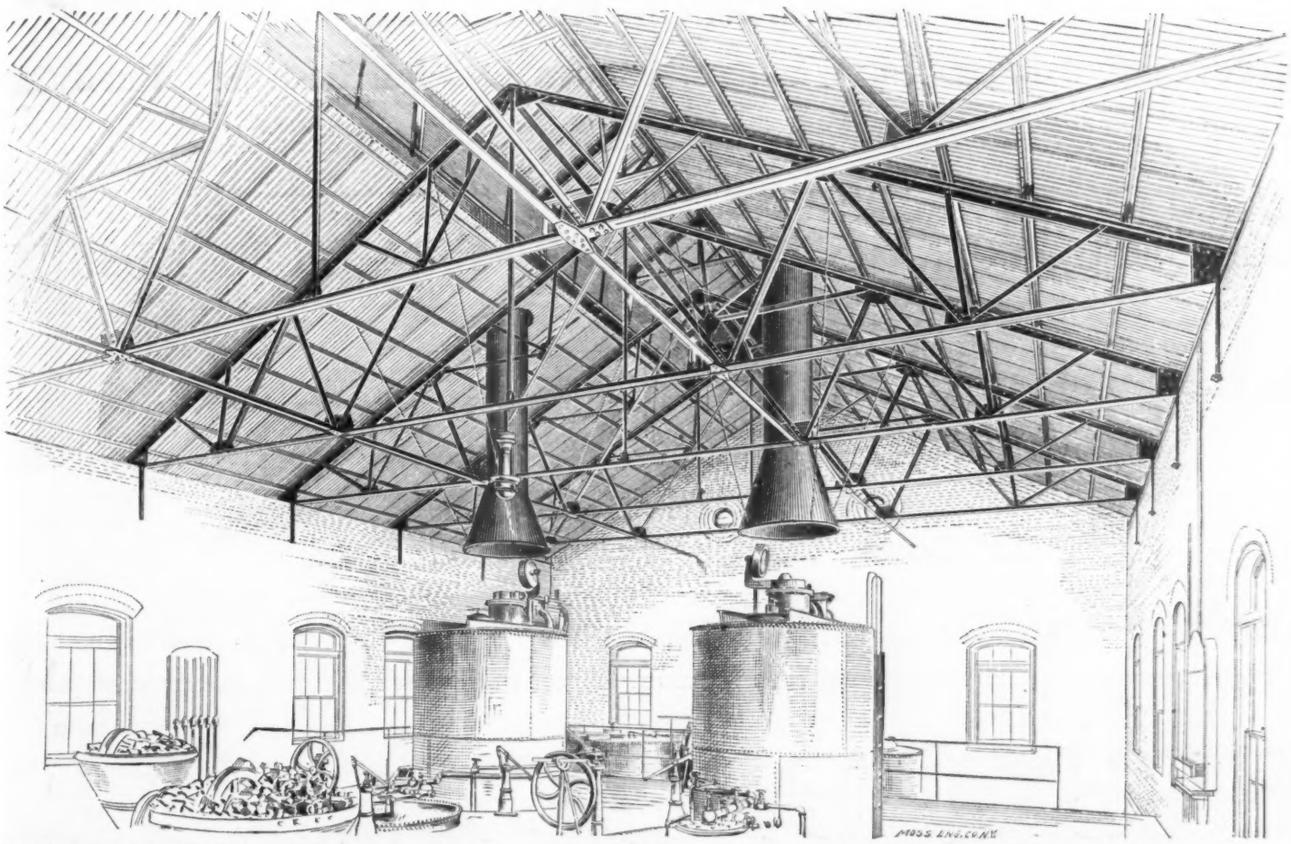
Send for Catalogue.

CHARLES M. JARVIS, President. GEORGE H. SAGE, Secretary. F. L. WILCOX, Treasurer.

THE BERLIN IRON BRIDGE CO.

Engineers, Architects and Builders of Steel Structures.



The above illustration is taken direct from a photograph, and shows the construction of an Iron Truss Roof designed and built by us for the Providence Gas Light Company, at Providence, R. I. The building is 40 feet in width by 100 feet in length, the side walls being of brick and the roof being entirely of iron—that is, iron trusses and purlins covered with corrugated iron. The building is ventilated by our Improved Ventilator, extending the full length of the roof, with side shutters opened and closed by cords from the floor. No woodwork is used in any way about the construction of the building.

BOSTON OFFICE, 200 Equitable Building.
NEW YORK OFFICE, 718 Bennet Building, Cor. Fulton and Nassau Streets.

Main Office and Works, EAST BERLIN, CONN.

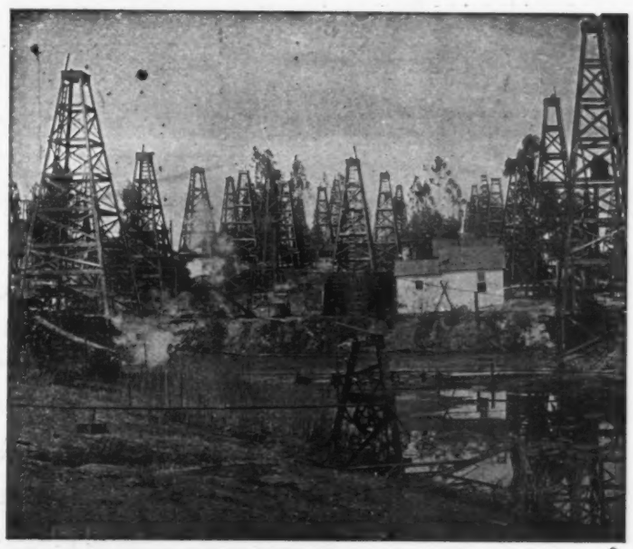
Gas Investments in California.

Nowhere else on this continent does such opportunity exist for profitable gas investment as on the Pacific Coast, since the perfection of the new LOWE Process for using the heavy crude California oils (of which there is an unlimited supply) without the use of any other fuels. Seven years' test proves the system to be perfect in every respect. Los Angeles alone, in addition to present street mains, has 150 miles of well built up streets without a gas main on them. To occupy this territory, and a large number of other towns now without gas, we have organized a parent company and a number of local companies covering some of the fastest growing cities in the United States.

Now is the time to invest, when the first capital will be able to double itself in a single year. This is also the most delightful residence section in the United States.

We suggest to those desiring gas investments, in large or moderate amounts—with or without active business connections—to come here and investigate; or, what is the next best thing, write us for particulars and prospectus.

The accompanying cut shows the oil wells in the suburbs of Los Angeles from which the Companies under the NEW LOWE GAS PROCESS obtain their supply of oil.



AMERICAN GAS & COKE CO. (T. S. C. Lowe, Manager),
406 Bradbury Building, Los Angeles, California.

AMERICAN GAS COMPANY

Constructors of Coal Gas Apparatus.

KLONNE-BREDEL

Recuperative Furnaces, Washers, Condensers, Purifiers and Purifying Machines, Ammonia Plant, Coke Conveyers, Etc.

Complete Works Erected with Guaranteed Results.

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GEORGE G. RAMSDELL, General Manager. **Correspondence Solicited**

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SOLE UNITED STATES AGENT FOR
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Gas Enriching Plants to Enrich Coal Gas up to 24 Candle Power, and Making a White, Bright, Non-smoking Gas

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LATEST IMPROVED GAS EXHAUSTER

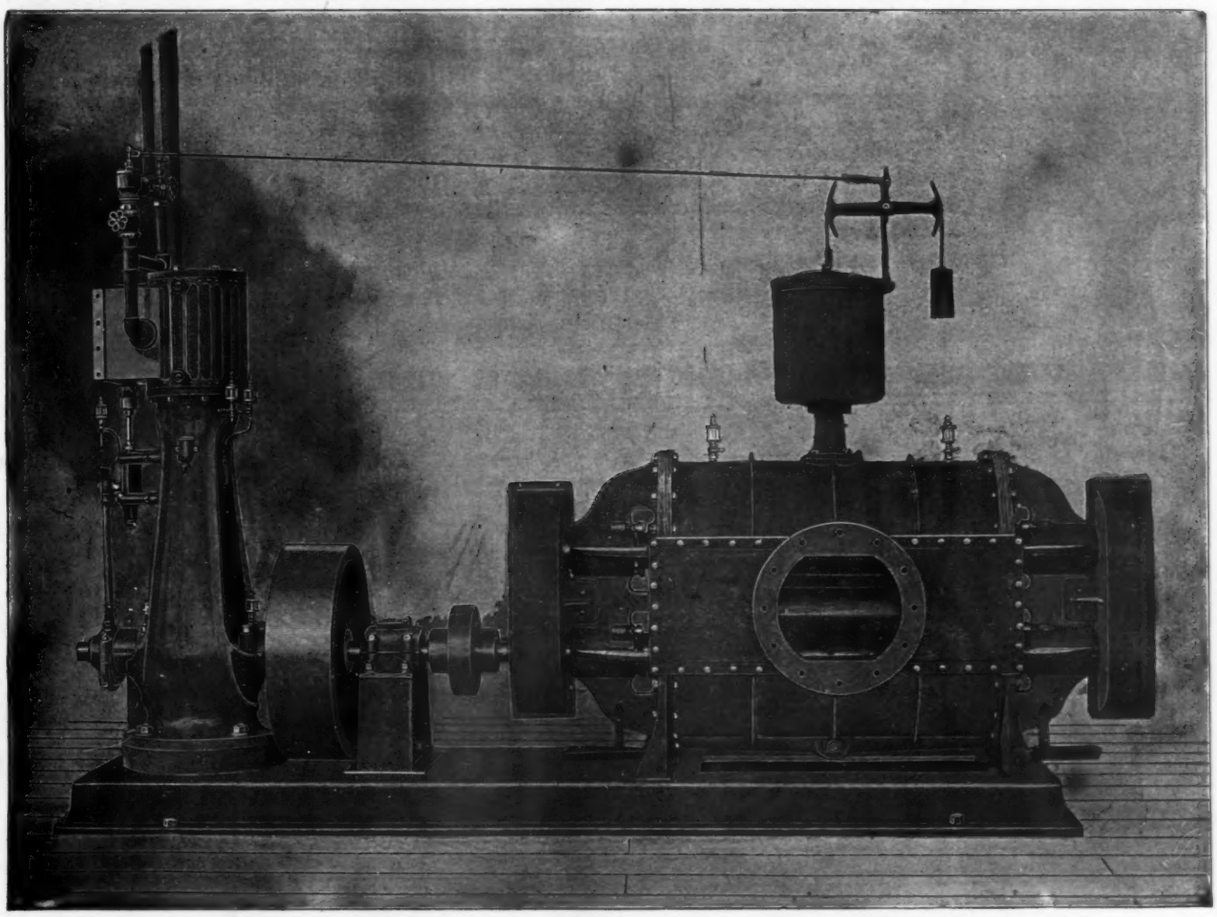
—AND—

NEW GAS GOVERNOR AND STEAM VALVE.

GUARANTEED TO REGULATE WITHIN ONE-TENTH OF AN INCH, WATER PRESSURE.

The Most Perfect Gas Governor on the Market.

MORE DIRECT IN ACTION. FEWER PARTS.
EASIER TO ADJUST THAN ANY OTHER GOVERNOR.



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—OWNS, CONTROLS AND OPERATES—

EXCLUSIVELY

THE NEW IMPROVED AND PATENTED STREET LIGHT BURNER.

STYLE No. 81.

Our PATENTED "STREET LIGHT APPLIANCES" have made WELSBACH STREET LIGHTING a complete success.

By the UNIFORM DISTRIBUTION of light on scientific principles a greater area can be lighted by our system and more economically than in any other way.

Where there are no gas mains already laid, we can furnish an equally good light by our **SELF-GENERATING NAPHTHA WELSBACH BURNER,** enabling Gas Companies to furnish a uniform light in all localities.

Lists of Cities and Towns in which we are now lighting under contract will be furnished upon application.

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CORRESPONDENCE SOLICITED FROM GAS COMPANIES AND OTHERS INTERESTED IN MUNICIPAL LIGHTING.

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THE SIXTH (AND CENTENARY) EDITION

— OF THE —

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This Edition of the "Handbook for Gas Engineers and Managers" is a great improvement on all previous editions Much of the text has been re-written, in order to keep the work abreast of the constant advances that are being made in the Gas Industry.

PRICE, - - $6.00.

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With Instructions for Care and Working of the Same.

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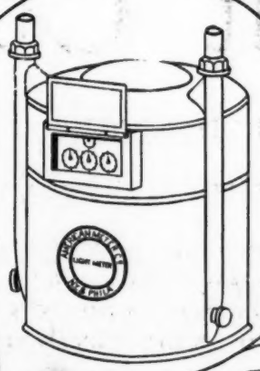
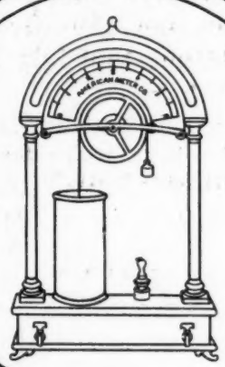
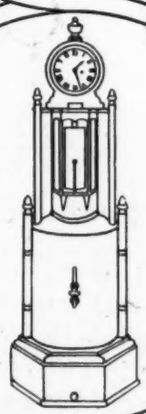
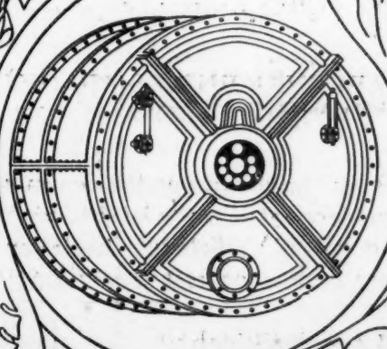








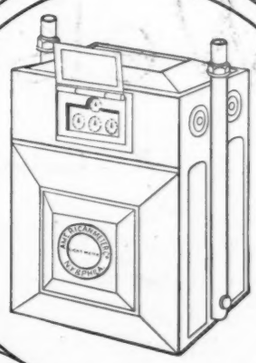
PUBLIC LIGHTING TABLE.

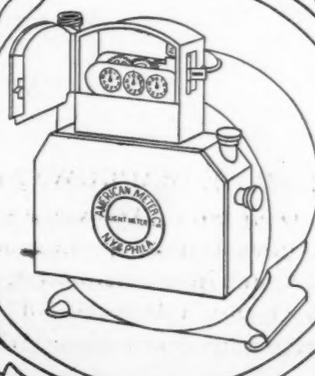
AUGUST, 1899.

Day of Week.	Date.	Table No. 1. Following the Moon. Light.	Extinguish.	Table No. 2. New York City. All Night Lighting. Light.	Extinguish.
				P.M.	A.M.
Tue.	1	7.40 PM	2.20 AM	7.10	3.30
Wed.	2	7.40	4.00	7.10	3.30
Thu.	3	7.40	4.00	7.10	3.30
Fri.	4	7.40	4.00	7.10	3.30
Sat.	5	7.40 NM	4.00	7.10	3.30
Sun.	6	7.30	4.10	7.10	3.45
Mon.	7	7.30	4.10	7.10	3.45
Tue.	8	7.30	4.10	7.10	3.45
Wed.	9	7.30	4.10	7.10	3.45
Thu.	10	7.40	4.10	7.10	3.45
Fri.	11	8.10	4.10	7.10	3.45
Sat.	12	8 30	4.10	7.10	3.45
Sun.	13	9.10 FQ	4.10	6.55	4.00
Mon.	14	9.50	4.10	6.55	4.00
Tue.	15	10.50	4.10	6.55	4.00
Wed.	16	11.50	4.10	6.55	4.00
Thu.	17	1.00 AM	4.10	6.55	4.00
Fri.	18	2.40	4.10	6.55	4.00
Sat.	19	No L.	No L.	6.55	4.00
Sun.	20	No L. FM	No L.	6.45	4.10
Mon.	21	No L.	No L.	6.45	4.10
Tue.	22	7.10 PM	8.20 PM	6 45	4.10
Wed.	23	7.10	8.50	6.45	4.10
Thu.	24	7.10	9.30	6.45	4.10
Fri.	25	7.10	10.00	6.45	4.10
Sat.	26	7.10	10.40	6.45	4.10
Sun.	27	7.10 LQ	11.30	6.30	4.20
Mon.	28	7.10	12 30 AM	6.30	4.20
Tue.	29	7.10	1.10	6.30	4.20
Wed.	30	7.10	2.10	6.30	4.20
Thu.	31	7.10	3.10	6.30	4.20

TOTAL HOURS LIGHTING DURING 1899.

By Table No. 1.	Hrs.Min.	By Table No. 2.	Hrs.Min.
January	215.40	January	423.20
February	184.40	February	355.25
March	187.40	March	355.35
April	166.50	April	298.50
May	158.00	May	264.50
June	140.50	June	234.25
July	150.30	July	243.45
August	168.30	August	280.25
September	179.50	September	321.15
October	213.20	October	374.30
November	217.00	November	401.40
December	238.10	December	433.45
Total, yr.	2221.00	Total, yr.	3987.45





OFFICE OF THE

Welsbach Light Co.,

BROAD AND ARCH STREETS,

PHILADELPHIA, PA., June 23, 1899.

To the Stockholders of the Welsbach Light Company:

In answer to the many inquiries received from the stockholders as to whether the Welsbach Light Company is interested in the Kern Light or the Kern Incandescent Gas Light Company, I am authorized by the Board of Directors of this Company to advise you that **THIS COMPANY IS NOT NOW AND NEVER HAS BEEN INTERESTED IN EITHER THE KERN LIGHT OR THE KERN INCANDESCENT GAS LIGHT COMPANY. The Kern Light, or, to designate it more properly, the Kern Bunsen Burner for use with an incandescent mantle, and the United States patents upon which it is based, were offered to this Company, which refused to purchase them upon the advice of its experts, Dr. Charles F. Chandler, of Columbia College, and Dr. Waldron Shapleigh, its Chief Chemist, and of its Patent Council, Mr. John R. Bennett, of New York City.**

This Company is not now and never has been interested in the Welsbach Incandescent Gas Light Company of England, nor is that Company interested in this Company. Your attention is called to the following correspondence, which defines **THE POSITION OF THE UNITED GAS IMPROVEMENT COMPANY**, whose name is mentioned in the advertisements which offer for subscription the stock of the Kern Incandescent Gas Light Company.

WELSBACH LIGHT COMPANY,
W. E. BARROWS, President.

WELSBACH LIGHT CO.,

BROAD AND ARCH STREETS,

PHILADELPHIA, PA., June 23d, 1899.

MR. THOMAS DOLAN, President the United Gas Improvement Company:

DEAR SIR: In yesterday's and to-day's New York and Philadelphia papers appear the advertisements of the International Banking and Trust Company soliciting subscriptions to the Capital Stock of the Kern Incandescent Gas Light Company. Among the names of the Directors of the said Trust Company published in the advertisements referred to appears the name of "George W. Elkins, United Gas Improvement Company, Philadelphia." As the United Gas Improvement Company has been prominently identified with the Welsbach Light ever since its introduction into the United States, the publication of its name in these advertisements, which also contain suggestions hostile to this Company, has greatly disquieted many of our shareholders. If you are willing to give me an authoritative statement of the position of the United Gas Improvement Company I shall be greatly obliged. Very truly yours,

W. E. BARROWS, President Welsbach Light Company.

THE UNITED GAS IMPROVEMENT COMPANY,
Broad and Arch Sts., Philadelphia, June 23d, 1899.

COL. W. E. BARROWS, President Welsbach Light Company:

Dear Sir: Answering your favor of even date, the United Gas Improvement Company is not now and never has been interested either in the Kern Incandescent Gas Light Company or in the International Banking and Trust Company. Mr. George W. Elkins is neither an Officer nor a Director of the United Gas Improvement Company, and does not represent the United Gas Improvement Company. Very truly yours,

THOMAS DOLAN, President,
United Gas Improvement Company.

The United Gas Improvement Company,

Broad and Arch Streets, Philadelphia.

THE STANDARD JUNIOR,

THE STANDARD DOUBLE SUPERHEATER,

LOWE WATER GAS APPARATUS.

Under Contract, 1899:

	SETS.	DAILY CAPACITY.
Fostoria, O.	1	250,000 Cubic Feet.
Derby, Conn.	1	750,000 "
Lowell, Mass.	1	1,000,000 "
Doylestown, Pa.	1	50,000 "
Darby, Pa.	1	400,000 "
Adrian, Mich.	1	125,000 "
Concord, N. H.	1	400,000 "
Sioux City, Iowa	1	750,000 "
Standard Gas Light Co., New York	3	5,400,000 "
Peekskill, N. Y.	1	250,000 "
Westchester, N. Y.	1	250,000 "
Jersey City, N. J.	1	1,000,000 "
Stapleton, N. Y.	1	750,000 "
London, O.	1	125,000 "
Chicago, Ills.	2	3,600,000 "
Putnam, Conn.	1	125,000 "
Mansfield, O.	1	250,000 "
Plymouth, Pa.	1	125,000 "
Athens, Pa.	1	125,000 "
Charlotte, N. C.	1	250,000 "
Total	23	15,975,000 "
Previously built	294	187,100,000 "
Grand Total	317	203,075,000 "

Established 1858. Incorporated 1890.
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Ground Fire Clay, Fire Sand and Ground Fire Brick in Barrels and Bulk.

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Established 1854. Incorporated 1869.

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Exclusive Agents for

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This is the *original* coal-consuming Furnace for Retort Benches. Burns either Coal or Coke. Full and Half-Depth Regenerative Furnaces for Benches of 6's, 7's, 8's or 9's erected complete.

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Gas Retorts,

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AND EVERYTHING IN THE FIRE CLAY LINE.

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Works, Weber, N. J.

Office, 633 East 15th St., New York.

Modern Recuperative Furnaces

And Standard Fire Brick and Gas Retorts.

Works, LOCKPORT STATION, PA.

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Fire Clay Goods for Gas Works.

SOLE REPRESENTATIVE OF THE McILHENNY REGENERATIVE BENCHES FOR THE U. S.

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GEROULD'S IMPROVED RETORT CEMENT

A Cement of great value for patching retorts, putting on mouthpieces, making up all bench-work joints, lining blast furnaces and cupolas. This cement is mixed ready for use. Economic and thorough in its work. Fully warranted to stick.

Price List, f.o.b. Galesburg or Mount Vernon.

In Casks, 400 to 800 pounds, at 5 cents per pound.
In Kegs, 100 to 200 " " 6 " "
In Kegs less than 100 " " 7 " "

C. L. GEROULD, Galesburg, Ills.

Eastern Agent. PERRY BORDEN, 19 Prospect Ave., MOUNT VERNON, N. Y.

Parker-Russell Mining and Mfg. Co.,

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417 Pine Street, St. Louis, Mo.

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OAKHILL GAS RETORT & FIRE BRICK W'KS

Our immense establishment is now employed almost entirely in the manufacture of

Materials for Gas Companies

We have studied and perfected three important points. Our retorts are made to stand changes of temperature, the strongest heats of the furnace, and the abrasion of feeding and emptying. We construct

Half and Full Depth Benches of Our Own Design,

Containing 6, 8 or 9 Retorts.

We have Greatly Improved our Recuperators. Coal or Coke can be used as Fuel in Furnaces.

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A. LAMBLA, Vice-Prest. and Supt.

BALTIMORE RETORT & FIRE BRICK CO.

MANUFACTORY AT

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Clay Retorts, Blocks & Tiles

FIRE BRICK, FIRE CLAY,
AND FIRE CEMENT.

Red and Buff Ornamental Tiles and Chimney Tops. Baker Oven Tiles 12x12x2 and 10x10x2.

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Sole Agents for New England States.

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A Guide to the Study of the Measurement of Light.

By WILLIAM JOSEPH DIBDIN.

With Numerous Illustrations. Price, $3.00 A. M. CALLENDER & CO., 32 Pine Street, N. Y. City

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Gas Plant Machinery

SOFT COAL OR COKE
WATER GAS GENERATORS
A SPECIALTY.

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Gas Engineers
INSPECTION AND ADVICE.

PLANS AND ESTIMATES
FOR IMPROVEMENTS OR
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(Successors to CONNELLY & CO.)
MANUFACTURERS OF GAS WORKS SPECIALTIES.

"IRON SPONGE." Saves money, saves labor, and is the most efficient purifying material ever offered as a substitute for lime. We guarantee a large saving, both in cost of material and labor.

AUTOMATIC GOVERNOR.
OVER FOUR HUNDRED NOW IN USE! NO WORKS COMPLETE WITHOUT IT!
WILL PAY FOR ITSELF WITHIN A YEAR! ITS SERVICE SECURES PERFECT DISTRIBUTION!
REDUCES LEAKAGE TO MINIMUM, and BENEFITS THE COMPANY and CONSUMER ALIKE!
IT IS THE ONLY RECOGNIZED AUTOMATIC GOVERNOR IN THE WORLD!

STEAM JET EXHAUSTER. Designed particularly for small works. Combines Exhaust Tube, Steam Governor, Gas Compensator and Bye-Pass Valves in the most compact form possible. Occupies but little space; uses very little steam; saves formation of carbon in retorts; increases yield 10 to 15 per cent. No works too small to use them profitably.

Prices given on all our specialties, delivered at any point in the United States. Correspondence solicited.

CONNELLY IRON SPONGE AND GOVERNOR CO., No. 357 Canal St., New York.

Hughes' "Gas Works,"

Their Construction and Arrangement,

And the Manufacture and Distribution of Coal Gas.

Originally written by SAM'L HUGHES, C.E.

Rewritten and Much Enlarged by
WM. RICHARDS, C.E

Eighth Edition, Revised, with Notices of Recent Improvements.

Price, $1.65.

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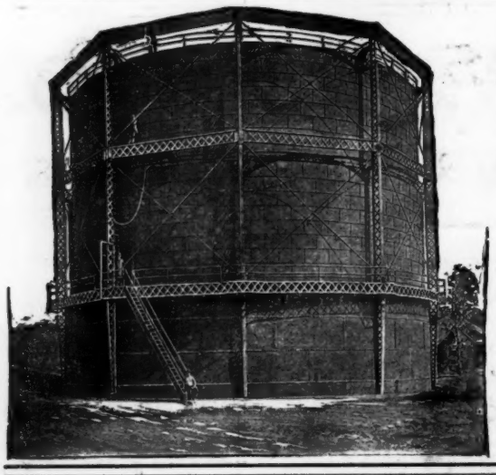

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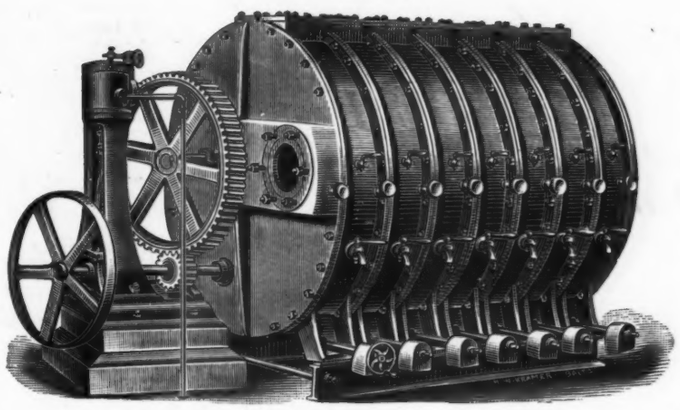

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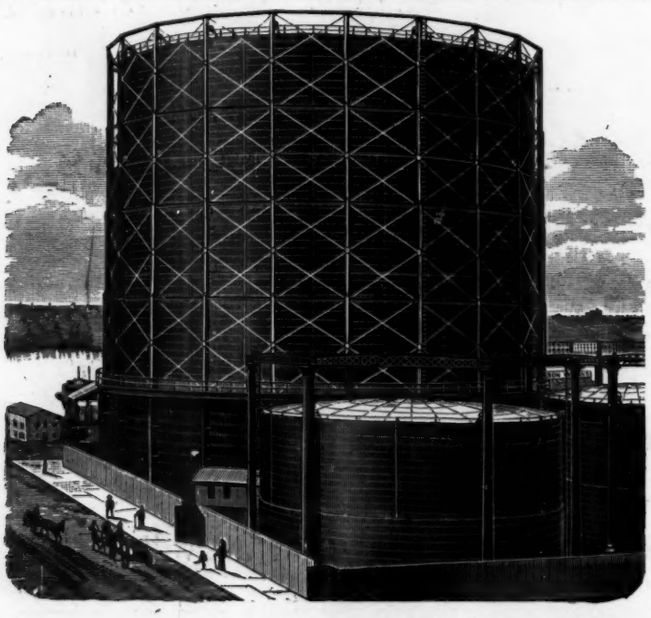

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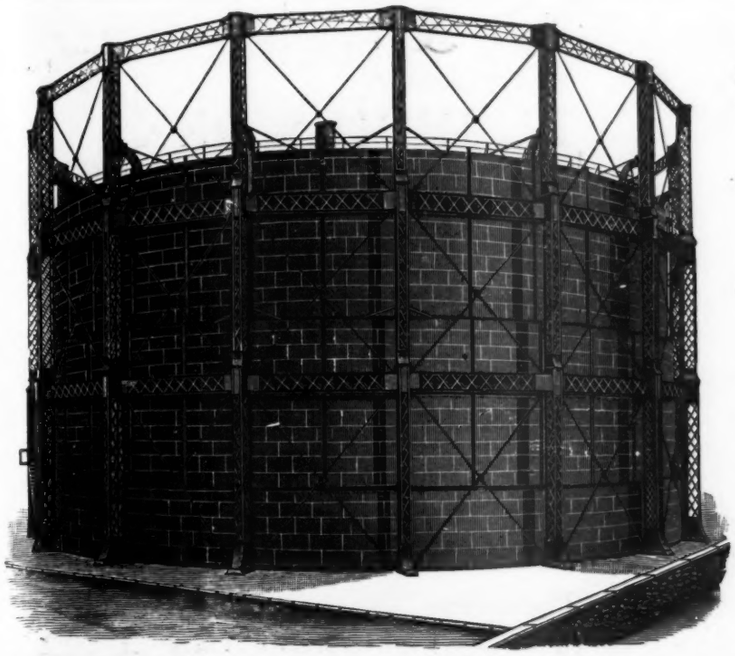

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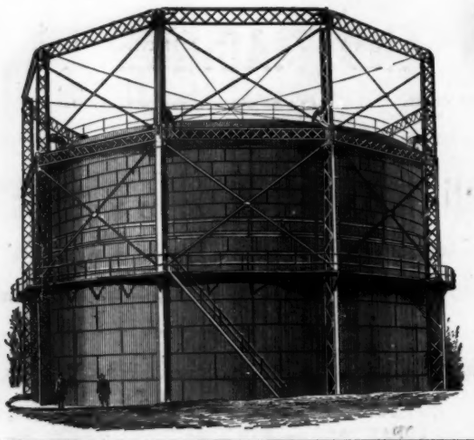

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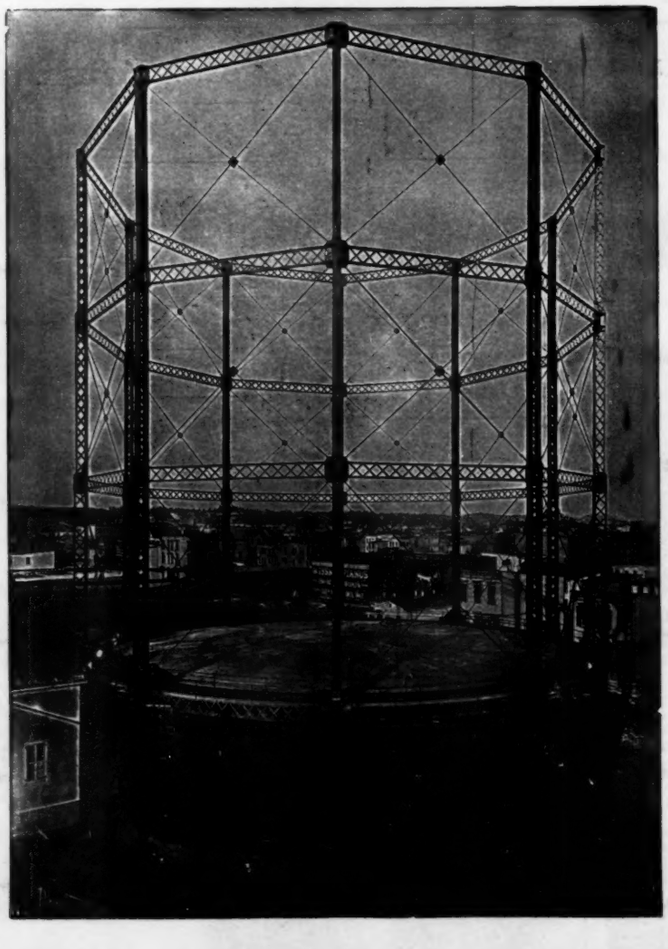

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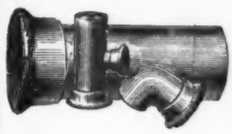

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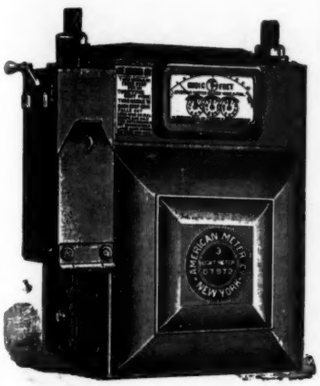

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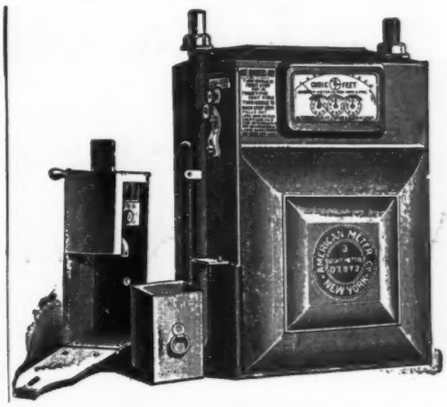
Their construction is such that they may be readily readjusted when the scale of gas rates is changed.



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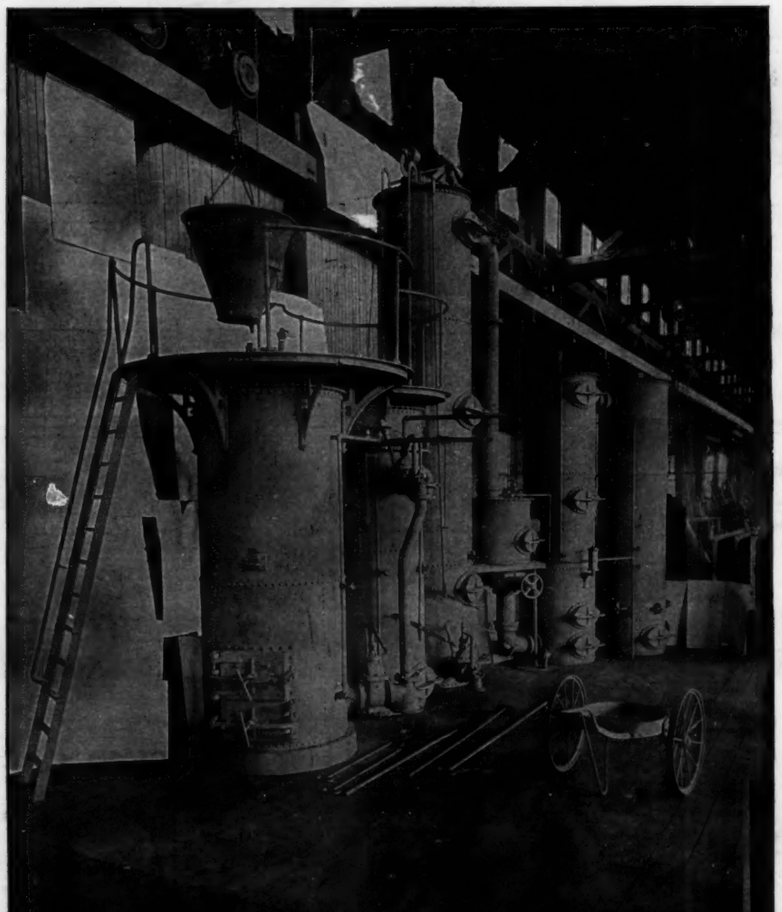
This is not special—it happens to all, only the others haven't the honor of appearing in the JOURNAL.



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